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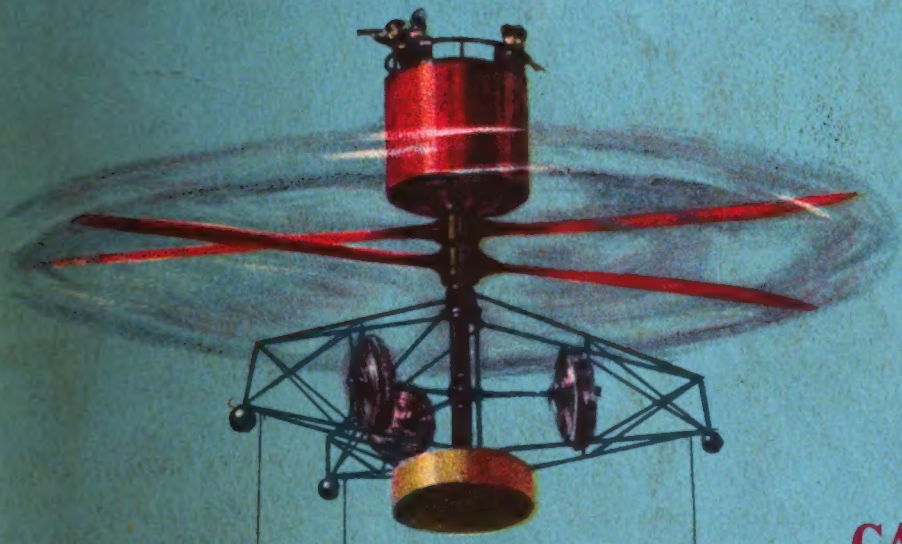

SIGHTSEEING CAPTIVE HELICOPTER

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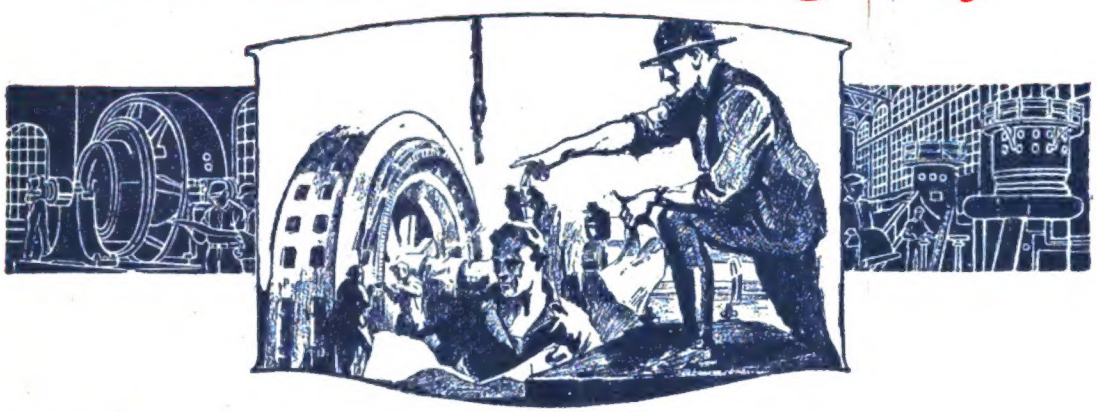

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Vol. IX
Whole No. 101

Science and Invention

FORMERLY
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233 FULTON STREET-NEW YORK.

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Perpetual Motion

PERHAPS it may be as well to blame it on the very unusual hot weather—at any event for the last few months we have been receiving perpetual motion schemes each and every day, sometimes one in each mail, from well meaning but sadly misguided "inventors."

It would seem that in this age of enlightenment, abounding in scientific publications, the *perpetuum mobile* fanatic would have died out long ago, but sad to say, such is not the case. He thrives merrily, and seems to multiply at an amazing rate. We hope—against all hope—that if a few thousand perpetual motion fiends see these lines, they will desist from their fruitless, time-and-money-devouring obsession.

Without wishing to offend anyone, let us state right here, that a very careful analysis of several hundred perpetual motion manuscripts on file at our office, discloses the simple fact that the authors of the schemes usually have very little—often no knowledge—of elementary, let alone of higher, physics and mathematics. If they had, they would of course never pen their manuscripts. Most of their "free power" schemes naturally exist only on paper—not one in a thousand ever having the courage of his conviction to build his contraption. Many are seeking capital to finance their brain-storms, and become deeply insulted, if we tell them the reason why their pet dream will never turn a wheel for a minute.

Most of these innocents do not even know that the United States Patent Office accepts no patent application of any device that smacks even remotely of perpetual motion—unless a working model is submitted. Needless to say, so far no model that worked has been submitted or ever will be. But even this knowledge will not deter our well-meaning friends, because they argue that THEIR machine will revolutionize all industry, and for that reason society has conspired against them, to shut them out and prevent the adoption of their inventions.

On the other hand, it is comparatively simple to build a perpetual motion machine, given a few conditions, to wit: 1st, eliminate *entirely* all the gravitational influences from the machine—friction, in other words; 2nd, do away with ALL heat losses; 3rd, enclose the machine in a perfect vacuum, to eliminate air resistance.

Given these requirements, you only need to start the mechanism and it will run "forever"—if you renew the wearing parts from time to time. Unfortunately condition 1 and 2 cannot be realized so far as our earth is concerned. Condition 3 can be approximately carried out.

Celestial bodies such as the earth, the moon, the planets fulfill all three conditions to a certain extent, but they will not roll on in space "forever." Our earth "runs" in a perfect vacuum and encounters no friction to speak of, except in tidal influences. But certain gravitational influences will reduce its speed or bring it to a stop at some time, tho this may be millions of years hence.

Yet the scientific man, who knows his physics, can build machines that run practically forever—but such devices make use of energy or forces abounding in nature, from which they derive their propelling or driving power. Such machines therefore are not in the ranks of the *perpetuum mobile*. To mention a few. There is in existence a clock that has run for many years without winding. It works by the natural expansion and contraction of metal bars, due to the change of temperature during the day. Of course the "power" gained is very little, just sufficient to drive the clock.

Then there is a similar device which works on a hygroscopic principle—the prevailing humidity and subsequent dryness in the air stretching and contracting a hygroscopic member, thus furnishing a few "flypower".

Further there are a host of devices—but few actually working—based upon capillary action. Minute quantities of liquids are raised up thru wicks or the like and the raised liquids thus elevated perform apparently microscopic amounts of work. But in reality they do not.

H. GERNSBACK.

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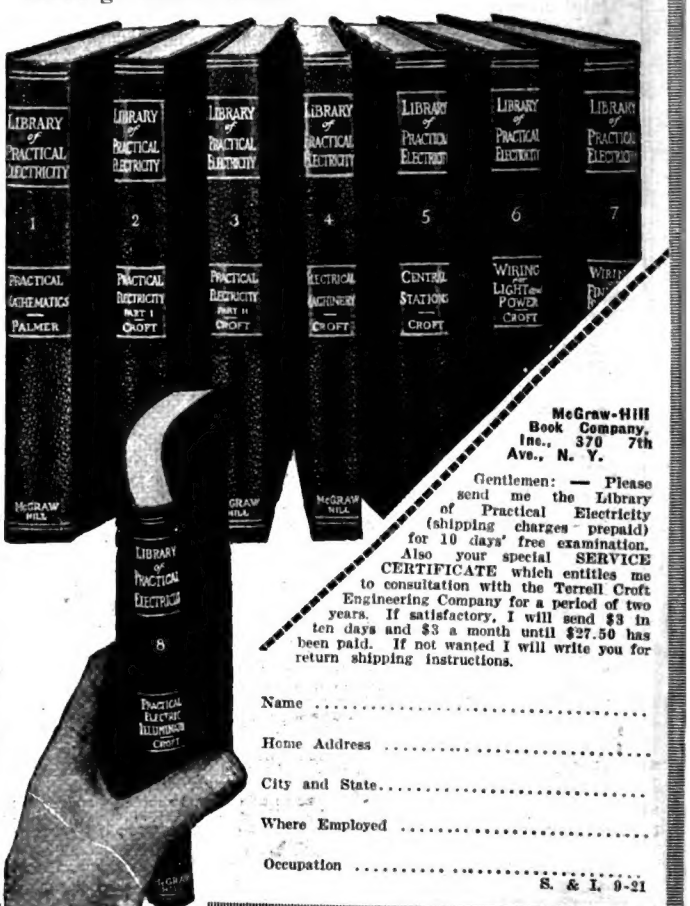

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Volume IX
Whole No. 101

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

SEPTEMBER
1921
No. 5

The Moving Platform Lunch

WE have had wished on us during the past few years about all of the moving platform schemes that we thought our able inventors could concoct. But at last something quite new looms on the horizon—nothing less than a moving platform provided with table and chairs so that you may now *travel while you dine.* Perhaps you have always had a great fancy to eat on a railroad dining car and here is one way of realizing your desires, especially if the walls are painted with waterfalls, mountains, and other scenic embellshments. Besides providing the novelty of traveling along as you dine, Mr. Lazarus Muntean, of Highland Park, Michigan, has provided a scheme for serving a large number of people in a minimum of time, and we find his invention very interesting and scientifically worked out indeed.

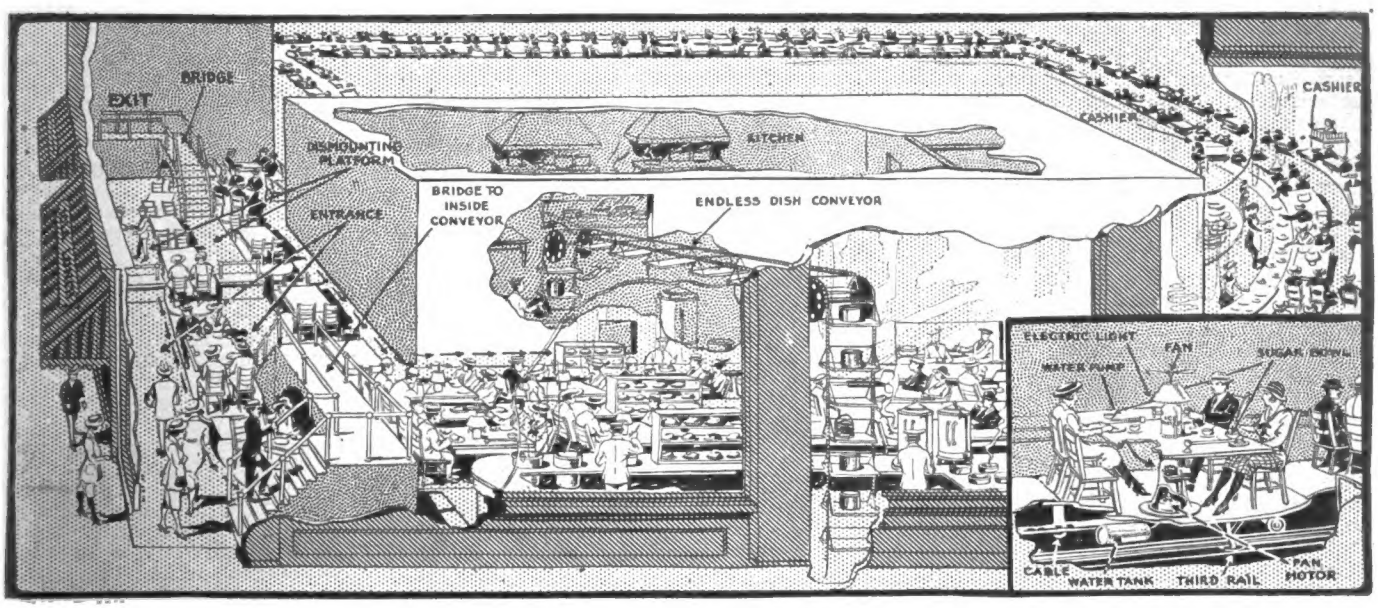
In the first place, Mr. Muntean's scheme calls for one or more loops of a moving platform, to be driven by electric motors or otherwise, and which platforms encompass the kitchen department, as the accompanying illustration shows. In the kitchen we find the necessary ice boxes, steam tables and ranges, etc. The victuals are supplied to the serving counters in front of which the diners move at their tables, by means of moving conveyors, as shown in the illustration.

The patrons sit down at the first empty table that comes along, and either consults a menu to be found on each table or have already consulted a menu at the entrance of the restaurant. The inventor has provided means whereby special dishes can be ordered when the patron first enters the restaurant, so that they will be ready when he arrives before the proper department service counter—meats, vegetables, pies, ice cream, etc. A small personnel is required only to dispense coffee and tea and keep the shelves of the serving counter filled with food. The dishes on the menu are made up in the same style as many of us are familiar with in the well-known Automat restaurants to be found in the larger cities, such as New York, Philadelphia, and Chicago.

The moving platform arrangements can be built in different ways to suit the requirements of different sized restaurants and depending upon how many people are to be served during the rush hour, such as at noon or in the evening. The table and chair platforms may be hooked up in trains, or they may also be joined to form a continuous platform or chain of tables. Of course the speed at which the tables move is slow so that the patrons can easily pick up the dishes they desire. After passing the last serving counter, the diners pass before the cashier's desk, where they pay for the amount of food they have selected. The diners may sit at their table and travel around the circuit until they have finisht their meal; then if they desire any more food, they select it and pay for the same when they make the second trip past the serving counters and cashier. Soiled dishes are transferred to endless belts which carry them to electric dish-washing machines in the kitchen.

The individual dining tables which move along on the platform are most ingeniously designed. Each table is fitted with an electric lighting fixture and shade as well as electric motor operating a fan. In the center of the table the inventor provides a fountain from which ice cold drinking water may be drawn from the spigot, the ice and water being contained in a compartment under the platform. The drinking water system is operated by an electric motor-driven pump. Thus, if the diner wants a breeze, he has but simply to push a button and the fan starts up, or if he wishes more light he clicks on the lamps in the electrolier.

Necessary electric current is supplied to the motors and lamps on each table thru a third rail and contact shoe arrangement, as the drawing clearly shows.



The Moving Platform Lunch Room is the Very Latest Idea in Restaurants. The Patrons Upon Entering the Restaurant Seat Themselves at the First Empty Table That Comes Along on the Moving Platform and Select Whatever Dishes They May Desire as They Move Slowly Past the Soup, Meat, Fish and Dessert Counters. After Passing the Last Serving Counter They Reach the Cashier and Pay for the Amount of Food They Have Selected. Needless to Say the Well Known Trolley Slogan—"Have the Correct Change Ready" Will Expedite Matters a Whole Lot, and Brother—We Can't Refrain From Thinking of the Humorous Side of this Really Worthy Invention—Can You Imagine the State of Mind of the Individual Who Changes His Selection Mentally Several Times Before Finally Selecting the Dish he Wants. If His Brain Does Not Function Specifically and Most All-Fired Quickly, He Will Still be Cogitating Over the Kind of Soup He Wants, When He Finds Himself in Front of the Pie Counter! Well, Here's Wishing the Moving Platform Restaurant Every Success.

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300 Mile Gun Now Possible

By H. WINFIELD SECOR

THERE was recently exhibited in New York City a very remarkable invention—a new form of gun using powder as the propellant, and which device, paradoxically, bids fair to find as many applications in peace time as in war. The accompanying photographs and diagrams show some of the features of this wonderful gun, a small model of which was demonstrated before experts by Dr. Miller Reese Hutchison, formerly chief engineer to Thomas A. Edison. The model of the gun was shown in action on the 51st floor of the famous Woolworth Building in New York City, and so accurate was the control of the explosive and its propelling power, that a steel projectile measuring about 4 inches long and ½ inch in diameter was fired point blank thru a ¾ inch steel plate. The gun was fired against the office wall and also downward toward the floor, with the ¾ inch steel plate interposed of course. It was really uncanny to think for a moment that such a device could be perfected, using powder as the active agent whereby it could be determined before-hand, that such a projectile would just pierce the steel plate, and would not pass on thru and kill a dozen people or so in its ownward flight thru floors and ceilings. But the wonders of science seem to be unlimited and one of the accompanying photos shows that this feat was not only performed once, but several dozen times on this same piece of steel plate, and furthermore, the gun was fired right before the experts. The writer of this article was present when one of the projectiles was fired thru the plate.

NO NOISE, SMOKE, FLASH OR RECOIL

Before going any further it may be well to state that one of the principal peace-time applications of this remarkable gun is its use in fastening patch plates to holes in ships *under water*, the gun operating when submerged just as well as in the air. Smokeless powder is used which eliminates the smoke factor; there is no flash at the muzzle, when the projectile leaves it at a velocity of 5,000 feet per second or higher, it being possible to raise this velocity to almost any desired factor within reason, the inventor states; it is noiseless owing to the slow release of the gases, somewhat similar to the Maxim silencer; and finally although the projectile leaves the gun at such a high velocity, the recoil is reduced to almost zero. In one test the gun was supported on strings and fired and it moved backward or *rebounded but one-tenth of an inch.*

As will be seen from the illustrations, the projectiles used in the demonstration are threaded for about two-thirds of their length. Thus when they are fired into the steel plate in which they are very firmly held, there is left protruding about one inch of good threads, so that a patch plate or other member can be placed over the threaded studs, a nut can be put on the same and tightened up to draw the plates into position.

We show in the accompanying illustration how under-water divers can use this new high velocity gun for shooting threaded rivets into the steel plate of a vessel's hull, so as to secure a steel patch plate over a hole or leaky seam, etc. The model of the gun demonstrated and shown in the photos is the one suited for ship repair and other steel work; it resembles in size and design the pneumatic riveting hammers with which everyone is familiar. The gun proper is shown in one of the diagrams and measures about 10 inches long and 1½ inches in

Noiseless, Smokeless Gun Has No Recoil

diameter and is made very substantially of a good grade of steel. The interior of the gun is specially designed and patents are pending on it, so that the full details of the interior mechanism are not available just yet, but a few points of operation, as explained by Dr. Hutchison, will show how this gun has proven the greatest surprise to ordnance experts in a decade. The main secret of it is that it burns the powder in a new way, so that about 85 per cent of the energy in the powder is utilized instead of about 10 per cent, the usual factor in modern ordnance. The powder is burnt slowly and the gas is allowed to accumulate so as to develop a very high pressure, which fires a projectile in the model shown, with the astonishing velocity of approximately 5,000 ft. per second, about twice the velocity of the highest speed of a rifle bullet fired from the modern army rifle. There is no energy wasted in forcing the gun backward, or as it is commonly termed, *recoil* or *kick*, owing to the extremely high velocity at which the projectile leaves the gun, which makes another saving of power. The idea is that the velocity is so quickly acquired that there is no time for a recoil to be developed.

Furthermore, it was stated that the explosive factor for a given size of gun, projectile, as well as grade and quantity of powder being known, the armor-piercing properties of the projectile could be calculated very exactly so as to serve for a check on further firing.

One of the photos shows two pieces of steel angle bar riveted to a flat steel plate by this gun, the mass having been cut thru the center of the rivets, so as to show just how they are held after they have past thru the ¾ inch steel plate. All that one hears when the gun is fired is a slight hiss and then a faint clink as the projectile pierces the steel plate. Due to the great amount of heat developed, at the point where the projectile pierces the plate with such terrific force, a small burr is thrown up on both sides of the plate, so that the holes in the patch plate or other member to be secured over the studs have to be countersunk for this plate to fit tightly against the second plate when the nuts are tightened up.

It will give some idea of how firmly the studs are held in the metal into which they are shot when it is stated that in one test it required eight tons' pressure to remove one of the studs.

The efficiency of this new gun in underwater riveting was recently demonstrated at the New York Navy Yard where Frank Crilley, the world's champion diver, descended to a depth of 35 feet in a regulation diving uniform and shot a projectile thru a steel plate ⅜ inch thick. Mr. Crilley stated afterward that there was no percussion under water due to firing the gun, and also that there was no recoil. It was this projectile or slug which was removed from the plate by subjecting it to a force of eight tons.

300 MILE GUN CAN FIRE FIVE-TON PROJECTILE

The accompanying chart shows what would happen if a hostile fleet should lay a few miles out of New York City and start bombarding the surrounding country with 300 mile guns, constructed on this new principle. If a large fleet or several of them attacked our coasts, and started hurling projectiles as far as 300 miles inland, it would create some panic we can well believe. Ordnance experts, who have examined this gun have stated that they do not see why such a 300 mile range is not possible, and it is believed that such a gun could be designed to fire a projectile weighing five tons or 10,000 pounds. In other words, such a projectile would be ten or twelve times larger than that used in the so-called German 70-*mile gun* which bombarded Paris. One of the well known experts who was present when the gun was fired and explained by Dr. Hutchison, was Hudson Maxim, inventor of smokeless powder, who was greatly pleased with the results shown and who stated that it was indeed a very remarkable demonstration.

This weapon or device is known as the Temple gun, and was invented by John Temple, a British subject, who discovered the principle in 1915, and really developt it after coming to the United States later on. This gun is now being examined by experts of the U. S. War Department, and for this as well as for reasons relating to the patenting, full details are not yet available, but we can be well satisfied for the present when we see the results of just what it can do.

Dr. Hutchison has recently organized an association for the investigation and development of worth-while or valuable inventions, thru co-operative efforts. In other words Dr. Hutchison is out to help the poor inventor, who has really got something meritorious and which would be worth patenting. Dr. Hutchison also announces that he and his associates have about completed an invention which will enable about 50 to 60 per cent of the deaf-mutes in this country to hear and ultimately to learn to speak.

Feature October Articles

Choosing a Vocation by Measuring Thought Velocity. By M. P. Von David, M.D.

Hail-Stones—What Causes Them?

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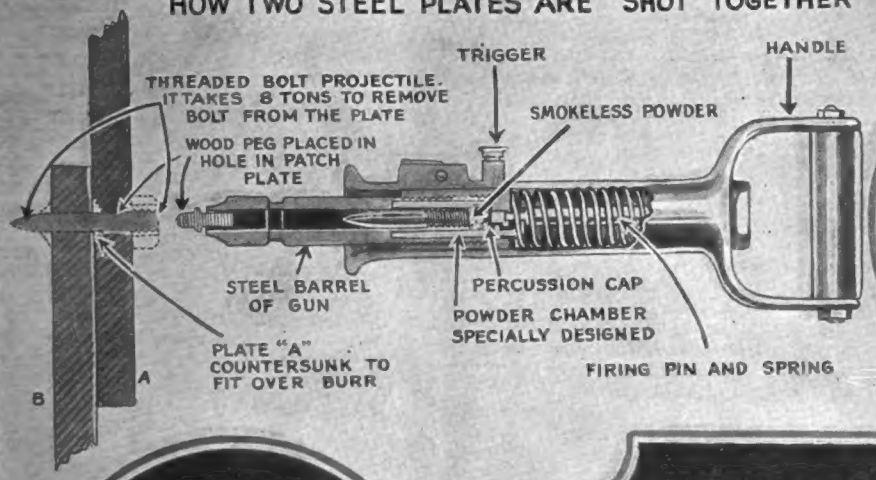
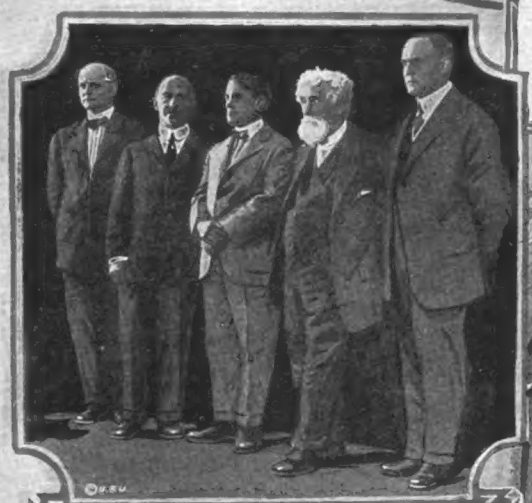
HOW TWO STEEL PLATES ARE "SHOT" TOGETHER

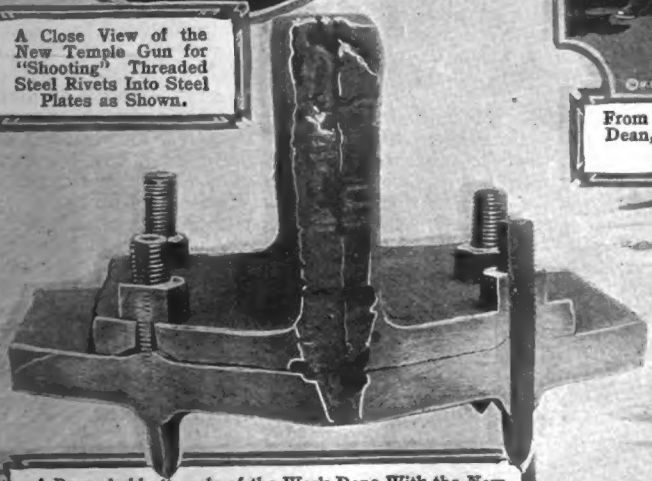

TRIGGER
HANDLE
THREADED BOLT PROJECTILE. IT TAKES 8 TONS TO REMOVE BOLT FROM THE PLATE
SMOKELESS POWDER
WOOD PEG PLACED IN HOLE IN PATCH PLATE
STEEL BARREL OF GUN
PERCUSSION CAP
POWDER CHAMBER SPECIALLY DESIGNED
PLATE "A" COUNTERSUNK TO FIT OVER BURR
FIRING PIN AND SPRING
B
A

Dr. M. R. Hutchison Firing the Wonderful New Gun Which Shoots a Projectile Thru a ¾" Steel Plate, and Half Way On'y.

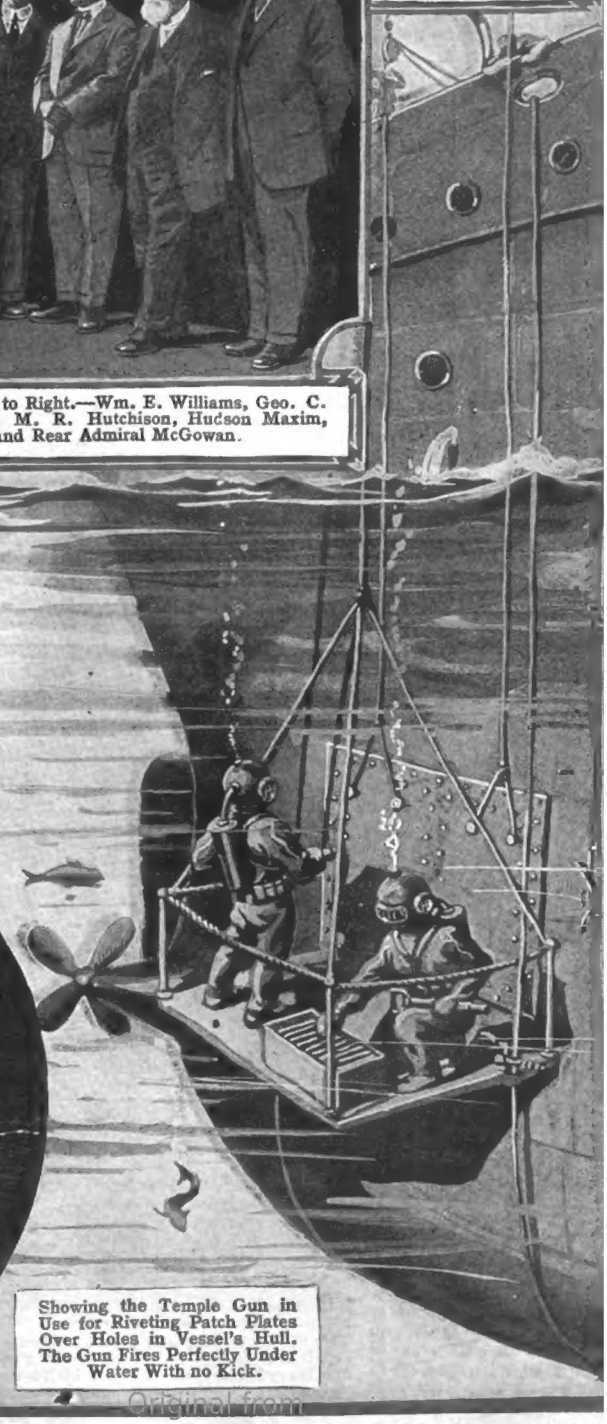
A Close View of the New Temple Gun for "Shooting" Threaded Steel Rivets Into Steel Plates as Shown.



From Left to Right.—Wm. E. Williams, Geo. C. Dean, Dr. M. R. Hutchison, Hudson Maxim, and Rear Admiral McGowan.



A Remarkable Sample of the Work Done With the New Temple Gun, a Section Having Been Cut Thru the Center of Two of the Bullet-Like Rivets.



Showing the Temple Gun in Use for Riveting Patch Plates Over Holes in Vessel's Hull. The Gun Fires Perfectly Under Water With no Kick.

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Scientific Pleasures

By ALICE ACKERSON

MR. and Miss Pleasure-Seeker had again come to the city to take their annual trip to Coney Island's Luna Park. This year, however, they were more surprised than ever, in that everything was so much more wonderful.

They first inspected the *Chute the Pig* game. Here Mr. Pleasure-Seeker took great delight in throwing balls thru holes at the bottom of the pens. Whenever a ball entered a hole, a door of the pig pen automatically opened, and the pig walked upon a platform and then slid down a slide in a very humorous manner. From here they entered the *Dodgem Ride*. This proved a most peculiar puzzler. Seating themselves in a small trolley chair, which was quite comfortable and protected by bumpers and grasping the steering wheel, they were ready. When the current was turned on, the chair started to move around in circles. Other people also out for pleasure were colliding with them. Mr. Pleasure-Seeker removed his foot from the switch and his car stopt, but still this did not prevent the attacks of others about him, who seemed intent on dislodging him from his position. Grasping the steering wheel and giving it a vigorous turn, he stept upon the floor switch and his chair shot out at great rapidity—backward—BAM! CRASH! and a couple of screams! A head-on collision or rather his tail end struck the forward end of the chair coming toward him. The Pleasure-Seekers were all upset. Miss Pleasure-Seeker grasped the steering wheel this time, and giving it less than a half turn, the chair changed its direction and after narrowly missing half-a-dozen other chairs they had the distinction of being the center of a melée which seemed to pile upon them from all directions. Squirming their way out of this and colliding several hundred times, seemingly with every person there, the current was finally shut off and they emerged.

These chairs are of very peculiar construction. They are mounted upon three double casters and are guarded by spring steel bumpers. Under the seat is an electric motor geared to a driving wheel, which occupies a position very near the center of the chair. This wheel engages with the metal floor offering sufficient friction to propel the chair. A switch in the floor of the car turns the current on or off and the trolley pole engages with a wire screen roof. The current is supplied to the motor through this trolley pole connection, the wire screen acts as one conductor, and the wheels and metal floor act as the other conductor, providing a ground. The motor and driving wheel is pivotly mounted and connected to the steering mechanism, so that when the steering wheel is turned, the motor is free to move in any direction and may be spun around and around.

After the Pleasure Seekers safely reached the boardwalk, they entered the House of Sappho, where Mlle. Davenport delighted them with statuary poses and where *No-Name*, who had been sent out by the Treasury Department at Washington during the Liberty Loan Drive, amused them. This automaton during exhibits is seen to plunge bodily from a speeding automobile and land in a position with all his machinery intact, ready to walk or ride again when directed to do so and when set upon his feet. His actions and appearance forms the center of interest to the pleasure seeking crowds.

A few moments later our friends were proceeding on their way in a tour of the park and again something new attracted their attention, when Miss Pleasure Seeker said, "Oh Jack, look at the pretty cupie dolls, won't you win one for me?" So he did. This was at the balloon race. Here a series of wheels with their cranks attached, about 12 or 15 of them, are turned by the participants in the balloon race. These wheels drive a small air pump, fitted with a by-pass valve and a governor. Should any operator turn his wheel too rapidly, the by-pass allows the air to escape and the balloon with a number assigned to it corresponding with the wheel, loses that much air. The participant who bursts his balloon first is the winner and walks off with a doll.

Mr. Pleasure Seeker was the fortunate victim in the twelfth round.

The excitement from the other rides having worn off by this time, both Mr. and Miss Pleasure Seeker launched their attack upon the *Tickler*. This mirth-provoking contrivance consists of three flat disks, the two extreme disks rotating in one direction and the center disk in the other direction. Upon these, five circular cars with their occupants are stationed, each car holding about six passengers who grip the side rails tightly. The cars are surrounded by gigantic inflated tires so as to take up the shocks as they bump around and slam into each other. Having seated themselves in one car, they proceeded on their wild excursion as the disks actuated by electric motors were started. As a matter of fact these disks practically play ping-pong with the riders, tossing them from one whirling segment on to another, and every time they do so the motion is changed with regard to direction. Bumps? Of course, and entirely unavoidable.

Some of the latest pleasure tortures may be found in recent patents of several individuals, one of them having been issued to Charles Austin Hoadley. This is a merry go-round or a carousel, in which the occupants move around in a circle while the floor on which the chairs or horses are stationed undulates constantly. It is clearly illustrated in our sketch.

Another clever patent was issued to Charles Jacobs. This consists of a series of dummy figures, the heads of which are inflated; a baseball is thrown at the objects and if a head is hit, the head bursts. The greater the number of heads a person breaks, the larger the prize. The bodies of course are firmly fastened to the table and clamps are arranged so that another head may be rapidly adjusted.

One of the greatest tortures is an amusement device, a patent on which was granted to Harry W. Peterson. In this device a series of cars pass over a continuous oval path, the tracks of which have curvatures and many irregularities. The body of the car is mounted upon springs, affording it perfect freedom of action, which, together with the shape of the tracks, causes the body to swerve violently and to pitch up and down and rock from side to side, as it proceeds on its course. This is also clearly indicated in our illustration. Two circular disks at either end cause friction upon a cable to which the cars are attached, giving them their forward movement.

Realistic Flag Waves at Night

By J. D. HOUSTON

It may seem strange as a coincidence, but I conceived the idea of my device, simulating a waving flag, on July 4, 1920. That day was quite calm and the flags drooped, which suggested the thought of the desirability of something to keep it waving, so that it would not depend on the wind. It was not long before the ideas embodied in my invention came to me after that, with the further thought that it could be so made as to show a fine effect at night by being illuminated. As is seen from my patent drawing, this may be done by throwing a spot-light on the face of the flag, which in that case would be made of opaque rollers. Another way is to make the rollers of hollow glass cylinders, stained so as to show the stripes and starry field, and illuminate them by the insertion of electric lights inside of the cylinders.

This *Luminous Flag* presents a wonderful effect mounted in a park at night, flashing and gleaming among the foliage; also when used in the halls of patriotic organizations.

This Clever Waving Flag Effect is Created By Revolving a Series of Glass Cylinders on Which Are Printed the Stars and Stripes, in a Wavy Formation. Electric Lights are Placed in the Tubes.

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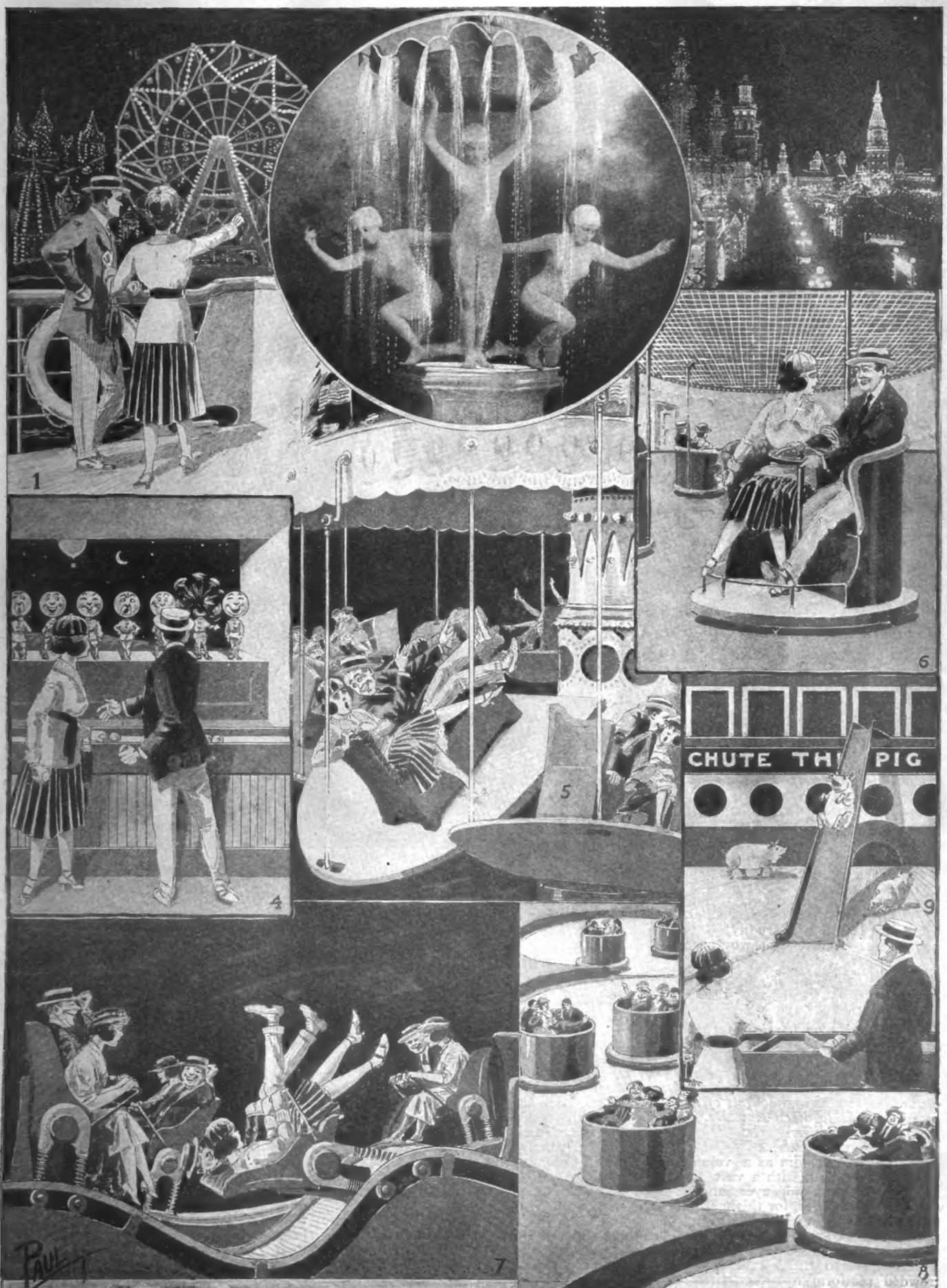
Scientific Pleasures



Mr. and Miss Pleasureseeker Approach Coney Island and Behold the Giant "Dip-The-Dip" Wheel (1). They Enjoy the Night View in Luna Park (3) and Visit One of the Shows and Admire the Human Fountain (2). The Balloons Forming the Heads of the Figures at (4) Break When Hit. Fig. 5 Shows a New Topsy Turvy Carousel Recently Patented, While at (6) We See One of Coney's New Electric Trolley Boats. Fig. 7 Shows a New Spring Controlled Roller Coaster Car and at (8) We See the Whirling Disks and the Cars Which Spin from One to the Other, While at (9) Is Shown the Pig Chute—When You Throw a Ball Thru One of the Holes a Pig is Released Automatically and Slides Down the Chute. © 1921 by Science and Invention

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Projecting Pictures In Daylight

AS long ago as 1897 experiments were made with a fine cloth impregnated with gelatine and covered with copal varnish as a lantern screen. Nothing came of it. Ten years later by using curtains alongside the screen, these curtains reaching out towards the audience, the attempt was made to put the screen in an individual obscurity, so that it would display projections of views altho the room proper might be lighted or in daylight. An arc lamp on 110 volts circuit, working at 30 amperes and some seventy feet from the screen gave excellent results for an audience of 350 people. It was about this time that a Belgian, de Mare, produced effects by projecting the slides from the wrong side of the screen; he even succeeded in doing this in the open air and he gave it an English name, "Without Darkness." Seven to nine amperes were used per square meter of screen for a room in very strong light, while it might go down to five amperes for less brilliantly lighted rooms. Later, other inventors tried ground glass for a screen, the roughened side being toward the spectators and the lantern being behind it so that the image passed thru that as in the case just described. Sometimes there was too much light emitted by the lamp from the dark chamber in which it was contained, whereupon a slightly smoked glass would be placed in front of the lantern, which cut down the crudity of the high lights. An arc lamp working at 15 amperes on a 110 volt circuit was sufficient for a screen of 2x3 feet area.

In the Four Illustrations Above We Show the New French Projector Doing Its Various Stunts. Placed With Its Lamp-House in the Inclined Position, It Projects Opaque Objects Up Thru the Objective. According to the Position Given the Mirror Above the Objective, the Views are Projected on the Ceiling of the Room, or on a Vertical Screen, or Elsewhere, as Desired, and Any Number of Successive Views May be Drawn Slowly by Hand, One by One Into the Field of View. One of the Illustrations Depicts the Manner of Projecting a Pearl Necklace; Others Show the Projection of Flat Objects. In All These Cases the Views and Things to be Shown Lie in the Horizontal Plane. Another Illustration Shows the Lantern Arranged for Direct Projection In the Usual Manner. In the Central Illustration, the Operator Holding it in His Hand, Is Producing Spot-Light Effects With It.

We then come to specially prepared surfaces of the screen. Here the trouble is that for daylight projection a very powerful light is needed. We illustrate here the Dussaud system of projection applicable for daylight use and for opaque objects or transparent lantern slides—A screen of over 9 square yards in area with an incandescent 300 watt lamp is used. The construction of the lamp is shown in our various cuts. One of its features is the perfect ventilation of the dark chamber so that the temperature after fifteen minutes is less than 80° F. The apparatus is shown arranged for projecting pictures printed or drawn upon a long band of paper that can be rolled upon a roller and thereby is drawn across the field of the instrument horizontally. The image is reflected upwards thru the objective and projected upon the screen. All sorts of solid objects can thus be shown. One of the drawings shows a special form of album for postal cards which are being projected. One cut shows a book as the object to be projected.

At a Lecture by Einstein

(Dr. Einstein recently gave one of his famous lectures in Vienna. Mr. Samuel of the Manchester (England) "Guardian," who attended, had a few thoughts of his own, which he gives us gratis. In doing so he merely hoped to picture the bewildering thoughts of the audience who tried to digest what Dr. Einstein put before it.—Editor.)

ONE expected him as a voluminously bearded Jew, with a vast forehead, bright, sparkling eyes, and certain obscurity of manner, for this, according to the conventions of the light literature which moulds our views, is the successful Continental professor from anywhere east of the Rhine. Instead there walked on to the crowded platform a rather tired-looking schoolmaster in middle age, clean-shaven but for a moustache, and indifferently dressed.

The vast Concert Hall was crowded. A week before the date of the lecture I had ransacked Vienna for a ticket to Professor Einstein's lecture on the *Relativitatstheorie*, and though the lecture hall was to be the large Concert Hall, with a capacity of nearly 3000, neither love nor money could procure me a ticket. In the end I obtained a place through the courtesy of an Inter-Allied Commission—a box seat close to the platform, so that I could watch the audience at first and then hear the lecturer without difficulty.

The opening remarks of the Professor were a disappointment. He seemed to deliver them with an indifference begot partly of familiarity with his subject and partly of contempt for his audience. Then, as he advanced into the argument, himself exhibiting only the mildest interest in it, a change came over us. We were aware, to our astonishment, of a sudden capacity for thought; we were actually able to understand him; we were following him through bewildering intricacies, and masters of ourselves, firm in our sanity. We began to forget ourselves.

"I strike my hand twice against the table," said the Professor, "one, two. What is your description of these phenomena? You are inclined to say that two knocks, at different moments, have been delivered on the same spot. Is this true? You are aware, of course, that this room, placed as it is on the earth, is moving through space, firstly because the world is turning on its own axis, then because the world is revolving round the sun, and then because the solar system is itself moving through space. It was therefore wrong to have said that two knocks were delivered on the same spot at two

(*Continued on page* 472)

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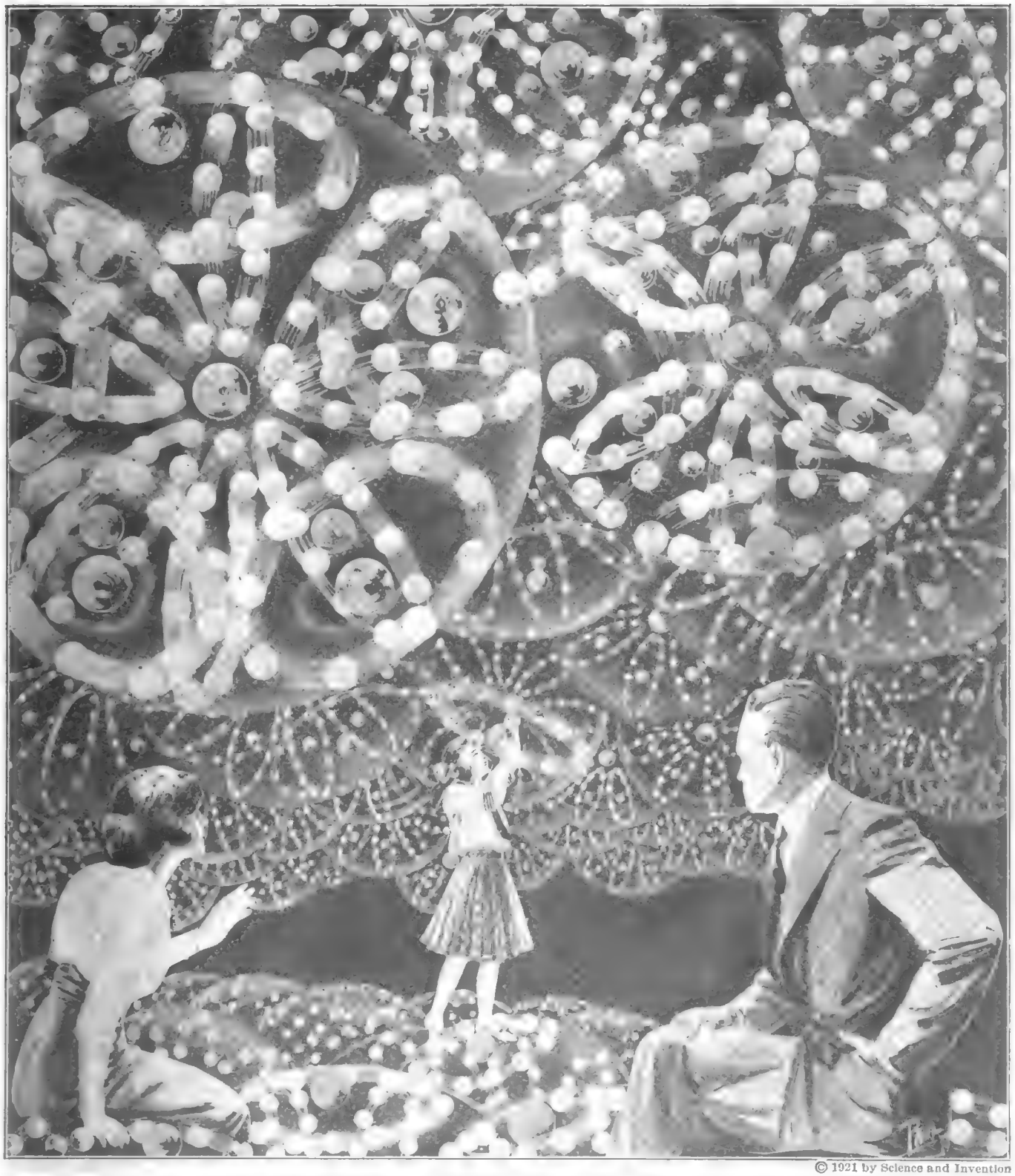

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Imagine These People to be the Tiniest Figures, Then What They Would See Inside of a Piece of Sugar Is Here Portrayed. The Rings of Electrons Spinning Around Their Respective Nuclei Would Present a Most Awe-Inspiring Sight.

Inside of a Piece of Sugar

THE modern molecule is the legitimate successor of and the word itself is the synonym of the atom of the old-time philosophers. The old atom was supposed to be the smallest possible division of matter, according to the epicurean theory. Less than two hundred years ago modern chemistry was evolved, and the old time atom proved to be divisible into smaller parts, and to these parts the name of atom was given, and the new name molecule was coined. Things went along this way very quietly until, with the study of radio-activity and its phenomena, a new conception of the atom was formed, and it was concluded, that the atom was a very open-work body, somewhat analogous to the solar system, having a central nucleus holding bound to itself like the planetary satellites of the central sun, a greater or less number of electrons, the number being invariable for the atom of each element in a neutral state.

The nucleus is supposed to have the mass of the atom concentrated in it, and the empty space, between nucleus and electrons, is proportionately comparable to that between the sun and the earth. Were it possible to collect the nuclei of enough atoms of gold for instance, to fill solidly with those nuclei a receptacle of one cubic inch volume, the cubic inch would run up into hundreds of tons weight.

Each atom is charged with energy; exactly what goes on between electrons and nuclei we do not know, but if we could unchain the energy of the atoms, the coal mines could close, we would cap the oil wells and consign hydraulic power stations to the scrap heap.

In our last issue we showed some pigmy

(Continued on page 471)

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Ink-less Printing

By PROF. T. O'CONOR SLOANE, Ph.D., LL.D.

FOR some centuries now we have had with us the printing press. Ever since the days of Gutenberg we have been accustomed to type and ink in order to make imprints upon paper. If we wanted a black imprint we used black ink. If we wanted to use three colors we make use of the three-color process, and use in succession yellow, blue and red inks.

Whoever has visited a printing plant where much printing is done must have been imprest with the fact that it is a messy and wasteful procedure. Not only this, but a considerable amount of time is lost in the so-called "make-ready." This in printer's parlance means underlaying and overlaying the cuts and type with fine pieces of tissue paper in order to get a perfect impression. To make-ready a form of sixteen pages for printing *Science & Invention*, takes three expert workmen at least two days steady work in order to get the electrotypes which are used to print each page of the magazine, to register properly and to get perfect copies in the end. Then again after we start running, the ink must be watched very carefully and much paper is spoiled in the process. The magazine publisher figures as high as 8 per cent. wasteage in paper, which runs into tremendous amounts during the year; and if three colors are used, as for instance for the cover, the publisher must at least expect to have from 12 to 15 per cent paper wasteage, due to spoiled sheets, imperfect impressions, sheets that offset against each other, sheets that smudge, etc. Will we always have to contend with such crude methods as are in use today? We think not. The day is coming when we will print without inks; when sheets will no longer be able to smudge; when they will not offset against each other; when the output will not be reduced by sheets sticking together due to static electricity in the air; when it will not be necessary to make-ready at all, says H. Gernsback.

Indeed, this is not a mere imagination but it can be accomplisht by anyone who will spend a certain amount in experimenting in order to turn out a commercial machine to do the work. Any of our readers can do the trick experimentally by reading what follows. We believe this article to be important enough to set people thinking along these lines, as we are firmly convinced that sooner or later inkless electro-chemical printing will come into use. We are certain that the next ten years will see the idea adopted.

We hear and read a great deal nowadays about wireless telegraphy and telephony and we may soon see the wireless transmission of power, so the idea of inkless printing harmonizes with the movements of the day.

If we go back a couple of generations, we find that inkless printing was used in the Bain chemical telegraph. In it a paper tape, impregnated with a chemical salt, past between the terminals of an electric circuit, and when the circuit was closed, a current would pass thru the somewhat damp paper, would precipitate coloring matter, such as iodine, in its pores and on its surface, so that the dot and dash signals of the code would be printed without ink. This principle has been used frequently since then in telegraphy, potassium iodid being one of the favorite salts with which to charge the paper.

Our illustration shows a project for carrying out chemical printing, and is intended to suggest the possibility of doing color printing by this system. The colors produced on paper, by passing a current of electricity thru it, may be varied by several methods. One of these methods is the impregnating of the paper with a solution of a chemical, which will be decomposed by the passage of a current, irrespective of the material of the electrode.

Paper charged with a weak solution of starch and potassium iodid will give a deep blue color if a current is past thru it. If the starch is omitted, the color will be a brown. These colors are produced irrespective of the material of the terminals.

In other cases the material of the terminals will affect the result. If the paper is impregnated with potassium ferrocyanid and if one of the terminals is of iron, a stain of Prussian blue is to be looked for. For many dyes we know that tin salts are a powerful mordant, so that at once the suggestion will occur that a tin terminal might be sufficiently decomposed by an adequate current to produce a mordanting effect upon some dye in the paper. One even thinks of the possibility of producing the gold salt known as the purple of Cassius. A more prosaic color may be looked for, if the paper were charged with one of the tannic acids. An iron electrode used with this chemical would give old-fashioned writing ink. It would be an easy matter to investigate various ink formulae to see if other inks could not be produced by an analogous chemical action.

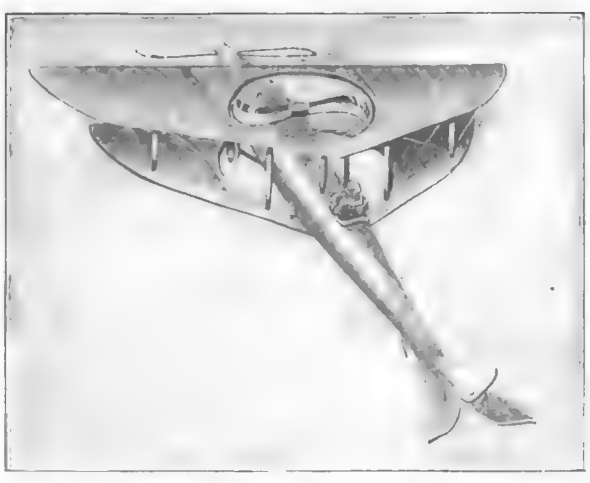
We speak of electrodes and thereby we would ordinarily understand a solid terminal of an electric circuit. But suppose that we substitute, for such, the rolls as shown in our drawing, and furthermore, suppose that the rolls carry letters and engravings on their surface. As they rotate these letters and designs will form or produce images of themselves upon the prepared paper virtually printing text and illustrations. It would merely be a matter of ingenuity and of rather simple research to carry out this idea. The research would involve the finding of practical color-producing combinations. Here the chemical or chemicals in the paper and material of the rolls would come into consideration.

It would seem that great speed could be obtained by chemical printing. Bain worked with a circuit permanently and constantly closed as far as the chemically treated tape was concerned. The opening and the closing of the circuit was done by an ordinary telegrapher's key at the distant sending station. His object naturally was to avoid the recording machinery of the Morse instrument, with its complexity. It will be remembered that in the early Morse instrument, a blunt stylus was sometimes used, indenting the paper and sometimes an inking stylus was employed. In both cases the stylus had to be prest against the paper for making marks or removed therefrom for the marking to cease. This required comparatively heavy mechanism and a good deal of mechanical complication, but Bain with his chemically treated paper tape, and his two electrodes with the paper intervening, did away with the heavy styluses with their attendant mechanism, and with the annoyance of the ink font.

What an advance it would seem, if the cumbrous printing press, with its enormous pressure, could be done away with, and the light fingers of electricity could be made to trace any desired character on a sheet of paper passing thru roller terminals. The pressure could be very light and the operation would be very quick and positive.

Vertical Rising Airplane

The airplane shown in the accompanying illustrations and devised by a California flier, represents a distinct departure in design. In order to enable the machine to rise vertically from the ground, a horizontal propeller is placed in an opening in the center of the upper wing. There is an opening also in the lower wing so as to permit the proper stream of air to pass down and escape from the horizontal propeller. This horizontal propeller brings about several new ideas in maneuvering an airplane or heavier-than-air flying machine. First, such a machine is claimed to be capable of rising above the ground vertically or nearly so, thus requiring a minimun of space in rising or alighting. Also the horizontal propeller will aid in causing the machine to lower gradually, and finally, it will enable the machine under the proper conditions to hover in approximately one spot, which is a very desirable feature of course in military observation or in aerial photography, such as map making, etc.



A single high-powered engine can be arranged to drive both the usual propeller, as well as the horizontal propeller, by employing suitable gearing, etc. Otherwise two engines may be used, one for driving the vertical propeller and the other for driving the horizontal air screw. Possibly the double engine drive would prove the most satisfactory, but with careful design a sufficiently flexible control of either propeller can undoubtedly be obtained from a single engine.

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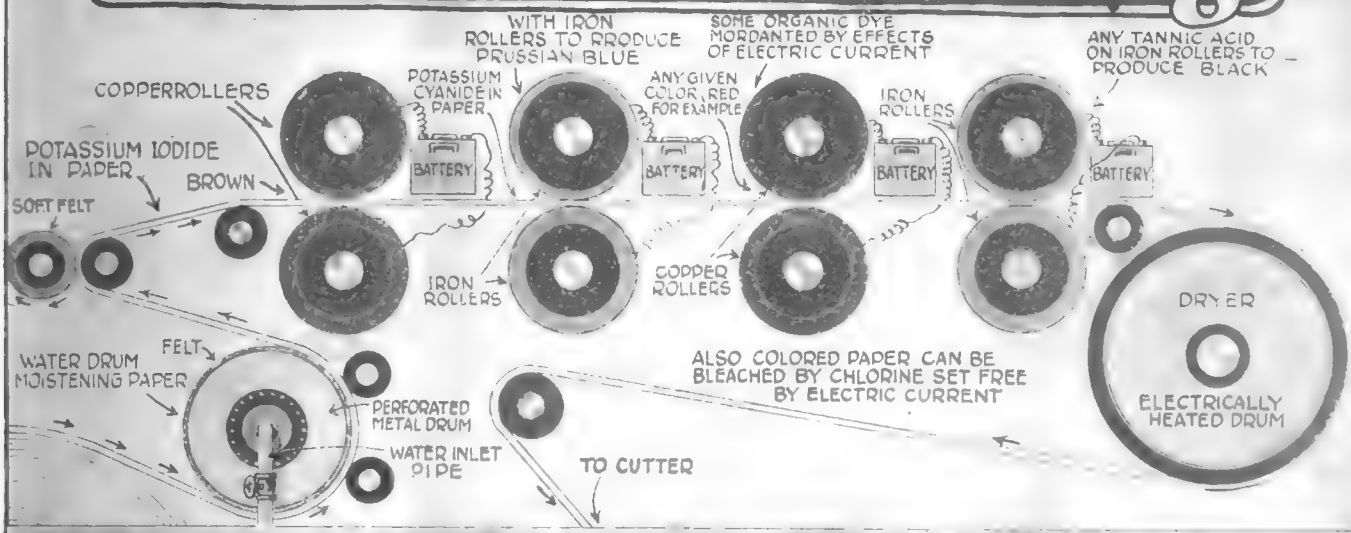
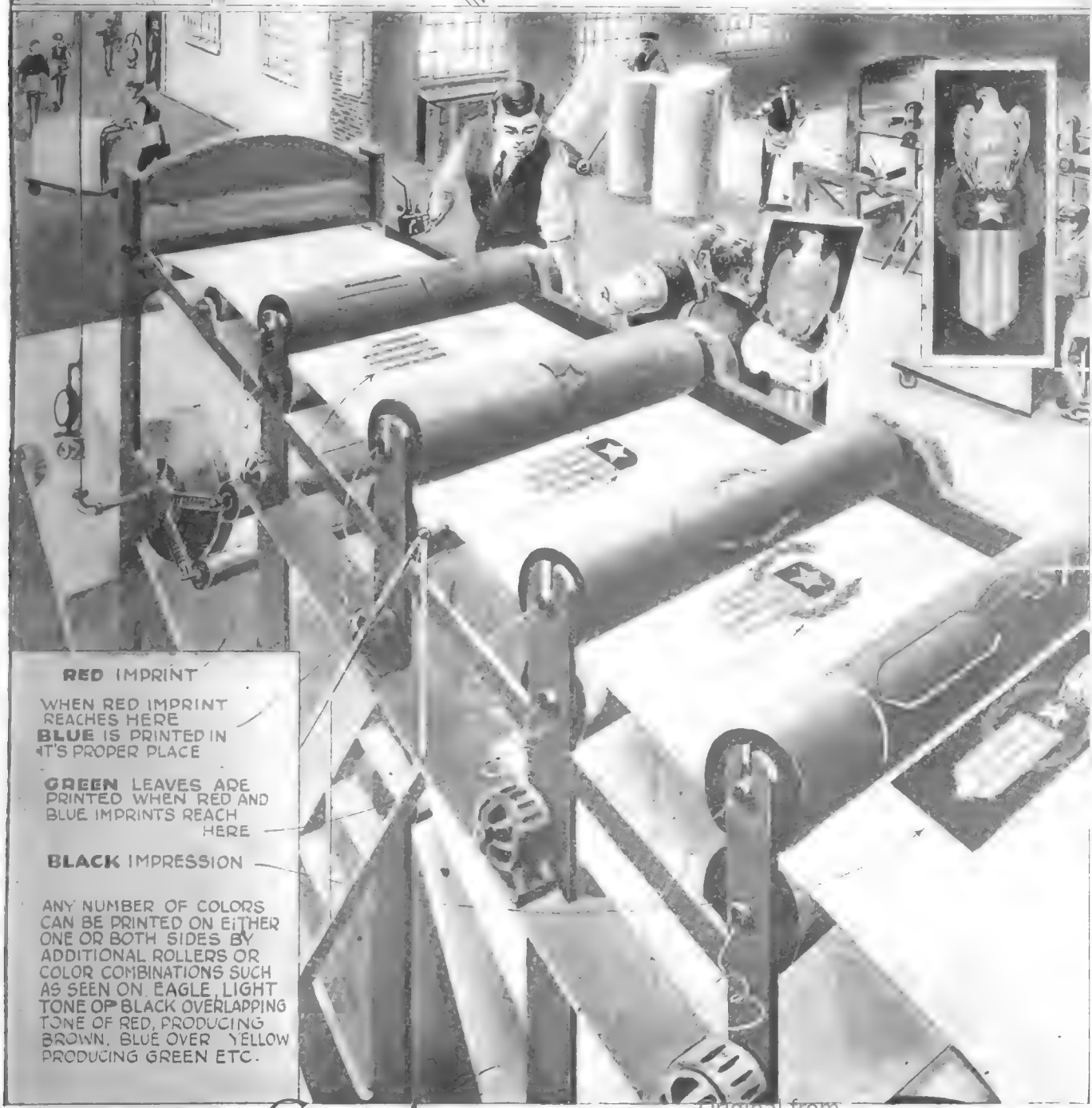
Inkless Printing





RED IMPRINT

WHEN RED IMPRINT REACHES HERE **BLUE** IS PRINTED IN IT'S PROPER PLACE

GREEN LEAVES ARE PRINTED WHEN RED AND BLUE IMPRINTS REACH HERE

BLACK IMPRESSION

ANY NUMBER OF COLORS CAN BE PRINTED ON EITHER ONE OR BOTH SIDES BY ADDITIONAL ROLLERS OR COLOR COMBINATIONS SUCH AS SEEN ON EAGLE, LIGHT TONE OF BLACK OVERLAPPING TONE OF RED, PRODUCING BROWN, BLUE OVER YELLOW PRODUCING GREEN ETC.

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The Transformation of Professor Schmitz

By GEORGE R. WELLS

SPEAKING of thrills, I believe last Saturday night gave me more than enough thrills and chills to last a lifetime. Poe's drunken adventures were tame in comparison. And it has all happened so quickly and so awfully that it seems to be a nightmare; a phantasm of the Devil's own doing. But no! It is not a phantasm. It is real. It all happened between 6 o'clock Saturday evening and 4 o'clock Sunday morning. Right now, Leo has a bandage around his head in evidence of its realty, and I am as nervous as if I had seen a ghost. The ending of a life so suddenly; it is incredible. But of course you do not understand. Let me start at the beginning. Then you will understand my sorrow.

Leo and I had always experimented with wireless and instruments of an electrical nature. Our dreams were of a brilliant future, when we should startle the world with some wonderful achievement in electrical engineering. Thus, with our hopes high, we came to Kansas State College, where we enrolled as electrical engineering students. One by one our ambitions materialized. We sent and received wireless messages at the college radio station. We learned to operate electrical motors and generators. Later in the year we began working on a wireless telephone. Only last week it was completed and proved successful. Here is where our adventure began. We were so delighted with our "Wirelessphone" that Leo wanted to show it to Professor Reid, head of the Electrical Department. I believe that Prof. Reid is also Leo's ideal, and a good man he is for a pattern. When he had carefully looked over our instruments he said, "You have done fine work boys. I am proud of you. How would you like to give a demonstration to-night at a meeting of the Science Club?"

Leo was rapturous. "Oh Professor, that will be what I call real sport. Come on Dick," he said, as he almost dragged me out of the office, "here it is, five o'clock. We will have to move some if we get that aerial up and the instruments ready in time. The Science Club is supposed to meet at seven-thirty."

It is needless to say that we were ready before time. We were as happy as two "kids," over our prospect. Of course we were supposed to be dignified college men. That is what our Rhetoric teacher tells us quite often, but we were not concerned with our Rhetoric teacher just then. We began to speculate on how many our audience would be, what they would do, and whether or not they would be pleased with the demonstration. Our chatter did not last long, however, for soon the people began to come in. By seven-thirty nearly all of the two hundred seats were occupied. As our stunt was the last one on the program, we took seats a short distance from the front of the room. On the front row of seats, and directly in front of me, sat a singular looking old gentleman.

"Who is that fellow, Dick?" said Leo, smiling. "Is that Steinmetz?"

"Steinmetz?" I said. "I suppose it is. I don't know him."

"Crazy" whispered Leo. "Steinmetz is the head man in the General Electric Research Laboratory. Of course that is not

(Continued on page 463)

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". . . 'No,' Answered the Professor. 'You Are Experienced at Wireless. You Just Press the Key. I Will Get in Myself. I Want to be the First Person to Go Thru, Anyway.' . . . Leo Became Deathly Pale. His Hand Seemed to Tremble Slightly. The Professor Motioned for Leo to Press the Key and . . ."

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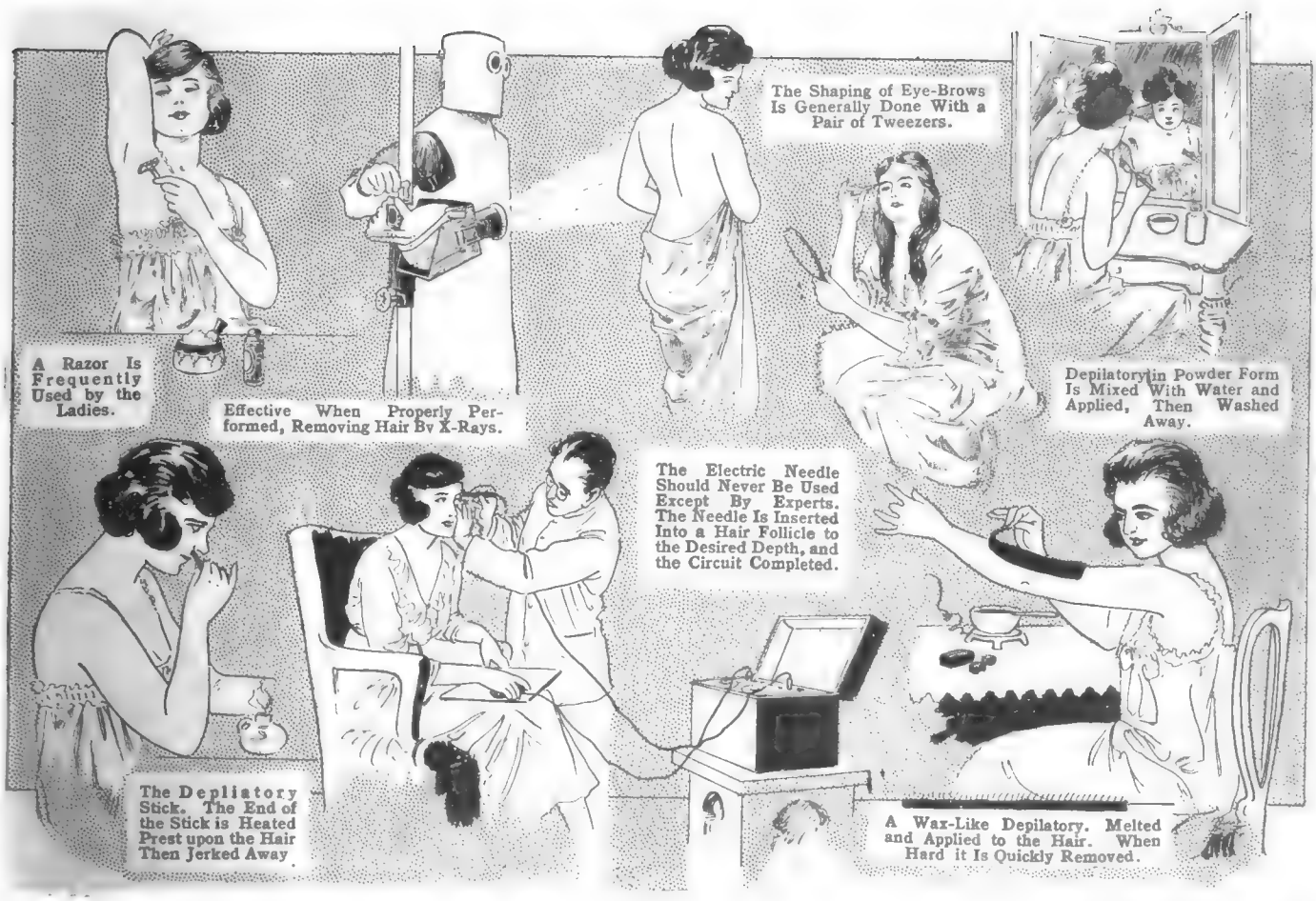
Hair Removers

By JOSEPH H. KRAUS


A Razor Is Frequently Used by the Ladies.
Effective When Properly Performed, Removing Hair By X-Rays.
The Shaping of Eye-Brows Is Generally Done With a Pair of Tweezers.
Depilatory in Powder Form Is Mixed With Water and Applied, Then Washed Away.
The Electric Needle Should Never Be Used Except By Experts. The Needle Is Inserted Into a Hair Follicle to the Desired Depth, and the Circuit Completed.
The Depliatory Stick. The End of the Stick is Heated Prest upon the Hair Then Jerked Away
A Wax-Like Depilatory. Melted and Applied to the Hair. When Hard it Is Quickly Removed.

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THIS discussion is intended for the more beautiful of the species and therefore, the male sex may refrain from reading it—but will they? It concerns hair removers in which category are included, depilatory powders, pastes, liquids, depilatory sticks and numerous other ways and means of removing superfluous hair.

Without a doubt the presence of hair on a girl's or woman's face is a very disagreeable and touchy problem, at any rate it seems so to the imaginative young debutante, who just *knows* that everyone notices the hair. Of course there is nothing her admirer can do to alleviate the girl's distress, and in nine cases out of ten he never notices the hair, unless he is particularly observing and usually he is not. Meanwhile the fair one resorts to depilatories.

The main or active ingredient of most depilatories is usually a sulfid or a sulfhydrate of an alkali or of an alkaline earth. These preparations give out a very disagreeable odor of sulfuretted hydrogen, resembling ancient eggs to a very great extent. If strontium sulfid is used in the preparation, the odor is not so disagreeable. The writer knows of one instance where a young woman used a standard depilatory in her boudoir, which room was subsequently closed for the season on account of the sulfuretted hydrogen.

In use the depilatory, if in powder form, is mixed to a paste with water and unless the depilatory is tolerably fresh, it is of little value. This paste is then applied to the area from which the hair is to be removed. The hair must be cut quite short with a pair of scissors before the application. It remains in contact with the skin until the hair has been softened sufficiently to allow for its removal without pain. The time when this is possible may be determined by trying small isolated areas from time to time. Thereafter the skin is scraped with a blunt instrument or washed with a sponge.

Too long contact of depilatories with the skin should not be allowed, as sometimes severe erosions, or even ugly sores, may be produced. This after-effect can be avoided by using sterilizing precautions and bathing or annointing the cleansed area with oil.

An ordinary preparation could be made by mixing two parts of freshly prepared calcium sulfid with one part each of zinc oxid and of starch and adding a small amount of an aromatic oil, such as oil of lemon or of peppermint. This powder should be kept in well stoppered bottles, and when being used is mixed into a paste with water, applied to the skin, and allowed to remain for about ten minutes and then washed off with water. Many of the best known depilatories, advertised thruout the country, contain a sulfid or a sulfhydrate, put into formulas similar to the above. These depilatories generally cause a slight tingling sensation and when this begins they are to be removed. None of them, however, can do more than destroy the hair a short distance into its follicle (see article in our July issue for an explanation of the hair and its appendages), so that *the hair will soon begin to grow again*. The process is exactly the same as shaving, but perhaps a little more injurious, in that any sharp sighted observer can immediately detect the artifice and see that a depilatory has been used. Shaving, for instance, with the regulation *lady* razor is just as efficient.

Another form of hair remover takes the shape of an ordinary pair of tweezers. But without a doubt the forceps stimulate a growth of new hair in the neighborhood of their application and if used upon the eyebrows will often distort it, so that when their use is discontinued a dense forest of hair growing in all directions of the compass results. In cases of hairy moles a knife is sometimes used to remove the hair.

Then there are hair removers which rely upon extracting the hair with the root and removing with it at times even its protecting sheath. One form is a mixture of fifty minims of tincture of turpentine, one hundred minims of oil of turpentine, two grams of castor oil and six grams of alchohol with collodion added to make up four ounces. This is repeatedly applied for several days so as to leave a film upon the skin which becomes heavier with the repeated applications. The film is then quickly removed like peeling off a porous plaster and the hair is removed with it. It is claimed that no pain is attached to the process but we much doubt this. Still another depilatory is made in a stick form by fusing nine parts of rosin and one part of beeswax. The finished product resembles a stick of sealing wax; one end is heated sufficiently to soften

(*Continued on page* 458)

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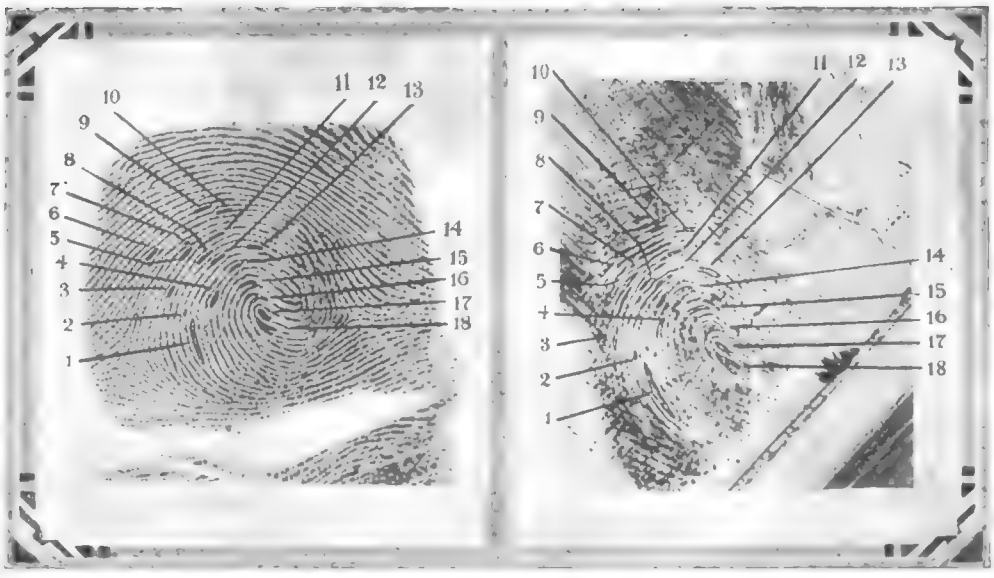
The Paris Police Laboratory For Criminal Investigation

IT was in 1883 that Alphonse Bertillon organized the *Judiciary Identity Service* in Paris for anthropometric measurements and photographic prints for the identification of criminals. The horizon of "bertillonage," as the French call it, grew more extended, and eventually a laboratory of scientific police work was established, which has developed tremendously under the direction of a prominent chemist, M. Bayle.



You May Not be a Finger-Print Expert, but You Can Appreciate How Photographic Science Linked This Criminal With His Deed, by Noting the Many Numbered Points of Agreement Between His "Record Print" at Left, and at Right, Finger Print from Scene of Crime.

This remarkable analyst and his assistants have to work with infinitesimal traces, with a few drops of a suspected fluid, with an imperceptible stain, minute threads from clothes, a few hairs, and the like. If the criminal works without gloves, finger prints will inevitably be found on the smooth surface of the safe, on a tumbler, window pane, or on some of the surroundings. If figures on a bond or note are changed by a bleaching agent, the electrical conductivity of the paper will be changed. Microscopic examination with the aid of photography will disclose whether a hatchet was cleaned with paper or with a rag disclosing if it was used to attack anyone. Notes with suspected erasures, are studied by ultra-violet rays to see if they have been tampered with.

When the Paris police take possession of a scene of a murder they at once telephone for experts, the Bureau usually sending three photographers, a finger print expert and a draftsman. The draftsman draws a plan of the place where the crime was committed, and his colleagues photograph every possible detail of importance. The most elaborate examination of the victim tells exactly how he has been murdered. Blood stains and every other indication are collected for analysis. Finger prints are searched for everywhere, on window panes, bottles, and papers. Here the greatest care has to be exercised in the way each piece is taken hold of, to avoid the impression of finger prints by the inspectors themselves. A special receptacle for holding bottles, tumblers and the like, so that they can be transported to the laboratory without impairing any finger prints, is shown in one of our illustrations. M. Bayle has devised a special photographic camera, shown also, for photographing finger prints under the light of two 2,000 candle power nitrogen lamps. Another illustration shows the print of the right hand thumb of a known criminal magnified five times, as on record in the police laboratory. Our next photo shows a thumb print found on the scene of a crime perhaps on a tumbler, or bottle. The numbers indicate eighteen points of identification, making it certain that they are the thumbs prints of the same criminal. An envelope with wax seal, may prove to contain sheets of paper, instead of bank notes. By dissolving off the wax, it can be determined whether the wax seals have been tampered with. By soaking it in water so as to dissolve the paste, it can be found whether it was opened in that way. In one case a little speck of wax found on the wrong part of the envelope is attributed to tampering. Sometimes enough of such indications are found to tell that the offense was committed in the bank itself.

In one case it was important to ascertain if a hatchet had been wiped with a piece of newspaper belonging to the criminal. If so, the hatchet would be indicated as having been his property. The dust from the hatchet was collected, dyed with Selleger's reagent, and was examined under a magnification of 3,000 diameters. The dust proved to be filaments of cotton, to that extent exculpating the supposed criminal, as it had not been wiped with the paper in his possession. Salt was found on the hatchet. It had simply been used to cut a salted or pickled ham.

The ultra-violet rays produced by a quartz tube mercury vapor lamp are now being studied from the point of view of utilization for these purposes. In case of a bank note, from which the date had been removed, a photograph by the ultra-violet rays brought out the missing date perfectly. A screen is used to cut off all infra-red rays, when these photographs are taken. It would seem to indicate the advisability of using a penetrating fluorescent solution in the ink used in printing bank notes, etcetera.

Electrical resistance is applied to determine the identity of samples of paper in cases of tampering with or counterfeiting bank notes. In one case the counterfeiter's paper, or rather the part tampered with by him, had twice the electric resistance of the untouched portions of the paper. Of course it might have been the other way, but in either case the identification is perfect. The examination of blotting paper will reveal perhaps the identity of what it has absorbed; it may be chemicals which have been used for erasing.

In one case the examination of the spectrum of stains on shoe laces revealed the characteristic lines of the painting of a bed in the criminal's cell, and the deduction was made that the criminal had strangled himself in his prison.

We only regret that space does not permit us to give a more extended description of the wonderful work done under the auspices of M. Bayle.

New Theatre Chair Saves Space

The invention of this new theatre chair, due to Robert Trucksess, and which is particularly designed for use in motion picture theatres and the like, provides construction of chairs, such that the seated patron is merely required to move or turn approximately 45 degrees, while remaining seated so as to allow a standing patron to easily pass without inconvenience to either.

Part of the seat portion of each chair is left off or omitted; the left corner is cut away diagonally, while the right corner of the seat is rounded off. From the fore going it will be apparent that when a person desires to pass between the rows of seats, the occupant or occupants of the chairs are merely required to turn at an angle of about 45 degrees. The manner in which the right and left portions of the seat are shaped gives ample space for both legs.

As the installation of such seats will afford so much comfort to the theatrical "fans," they will probably be adopted in many leading theatres. The photographs show just how this chair works in actual use.

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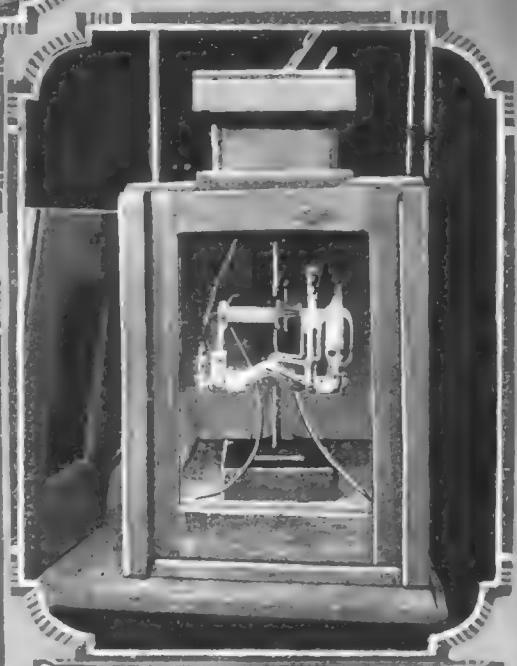
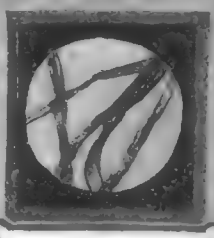
French Scientists Have Contributed a Great Deal to the Cutting Down of Crime, and Electricity as Well as Chemistry and Photography Have Been Harnessed so as to Work Hand in Hand as an Aid to the French Detective Forces. The Photo Above Shows an Expert Examining a Suspected Bank Note for Erasures by Photographing the Bank Note, by Means of Ultra Violet Light, all Other Actinic Light Being Screened Off.

Receptacle for Transporting Objects Suspected of Containing Finger-Prints. It Carries Such Without Touching Their Surfaces.

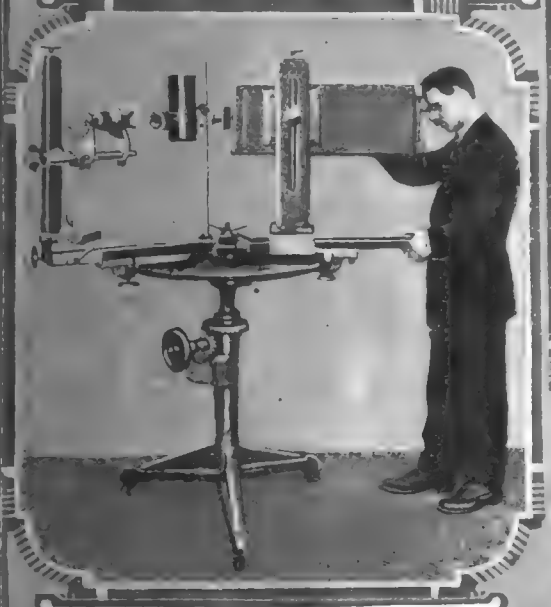


Here is the Georges Ultra-Violet Mercury Vapor Lamp Used in Making Photographs of Suspected Bank Notes and Other Paper Money. Hand Written Notes Which May Have Been Altered by Using Various Chemicals and Inks, Can Often be Made to Disclose Their Original Wording or Message.



Microphoto of Paper Fibers, Compare With the Microphoto Below of Cotton Fibers.

Above Appears Micro-Photo of Cotton Fibers. Both of These Micro-photos Refer to the Hatchet Shown in Lower Left.



Photography Is Once More Brought Into Play, as Shown in the Photo Above, Where We See One of the French Camera Experts About to Photograph Several Finger Prints on a Glass Tumbler.

It Was Suspected a Murderer Had Wiped This Hatchet With Paper. Threads Were Found on the Hatchet and When Examined by Micro-Photography, They Were Found to Be Cotton, Exonerating the Prisoner.

A Corner of the Electrical Testing Laboratory Maintained by the French Police Department in Paris. The Investigator Is Here Determining the Electrical Resistance Offered by a Solution of Certain Chemical Proportions. Many Interesting as Well as Wonderful Clues Have Been Discovered in This Laboratory, Which is Fitted With Delicately Adjusted Apparatus for Measuring Resistances and Other Factors.

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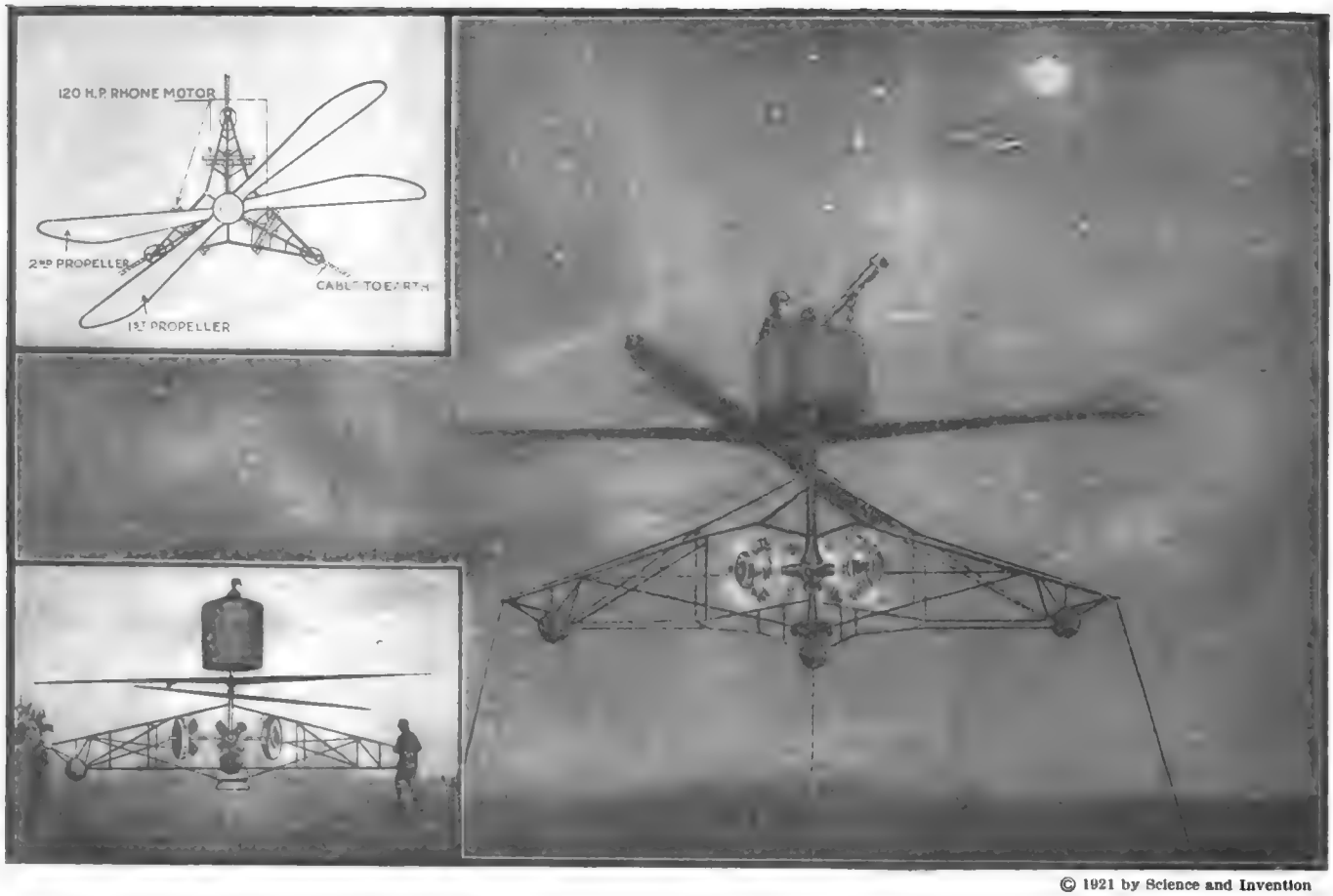

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Upper Left.—The Petroczy-Karman Machine as Viewed From Top. Lower Left.—Actual Photograph of the Same Machine Just Before Flight. This Machine Actually Made a Great Number of Ascensions.
Center Illustration.—A suggested Use of the Captive Heliocopter. Astronomers Have Always Felt the Need to View Celestial Bodies From a Great Height in Order to Get Rid of the Atmospheric "Boiling" Effect Which Precludes Good Seeing. By Using the Captive Heliocopter and Ascending Several Miles Above the Surface of the Air, Valuable New Knowledge Would be Gained, as at Such Heights Astronomical Observations Would be Greatly Improved.

A Captive Heliocopter

By H. GERNSBACK

WE have publisht in these pages descriptions and illustrations of a number of heliocopters, as our readers are well aware. So far, nothing really worth while has been produced, and most of the heliocopters, that have been built, do not seem to be able to keep their equilibrium when aloft. A sudden gust of wind is almost certain to throw them over with disastrous effects. How is this effect to be overcome?

During the war there was produced a machine that actually flew, or rather rose, to a great height, and stayed there as long as the motors revolved. This machine is shown on this page, and was constructed by two Austrian army officers, Messrs. Petroczy and Karman. It was a heliocopter, which was to be used at the front for observational purposes, instead of the usual blimps or observation balloons.

In our illustration in the upper left hand corner, the construction of the machine is clearly indicated. The structure comprises an equiangular, radial, three-armed skeleton as shown, made of steel. In each leg of the frame work is placed a powerful 120 H.P. Rhone gasoline motor. The three motors are all coupled to the central axes, which support the two powerful propellers, which have almost twice the diameter of the frame work. These propellers rotate in opposite directions. The idea of using three motors was adopted simply in order to keep the machine aloft, should one of the motors stop; or even if two motors stopped, there would be still one motor to operate the propellers to prevent a violent descent of the machine.

In the small lower view, our illustration shows the actual Petroczy machine before flight. We now come to the novelty of the machine, and that is the means to stabilize it, and to overcome the danger inherent in most heliocopters, which is the accidental turning over of the machine while in flight. The inventors used three cables, which were fastened one to each point of the triangular steel structure as shown. These thin steel cables were reeled out by means of three electric winches as the machine rose upwards, the cables remaining taut at all times, while the machine was in flight. These cables effectively stabilized the machine, and many ascensions were made.

When it was desired to come down, the propellers were simply rotated slower, and the landing was made without trouble. The three large steel balls suspended at each point of the star-like structure are also for stabilizing purposes, keeping the center of gravity below the motors. All of this helps to keep the machine from upsetting while in flight.

The deplorable part about this machine is that its efficiency was very low. The machine itself weighed about 1,300 pounds, and it took 360 H.P. to lift it, which is bad mechanics. This trouble was due to the fact that it had not been realized at that time, as it has since been demonstrated by our own inventors, as for instance, our Mr. Cooper Hewitt and the late Professor Crocker, that the secret of the heliocopter lies in enormously large propellers. If such propellers are used, the efficiency of the machine increases very considerably, because the power necessary to lift the machine decreases proportionately.

We are certain that we will see these machines in use for sight-seeing purposes, once they are perfected. Our suggestion on the front cover shows this graphically. One of the most important uses for this machine, however, will undoubtedly be for astronomical purposes, as depicted in our large illustration. It is a well-known fact that all astronomical observations today are dependent upon the atmosphere. Even on clear days the "seeing" is not always perfect, due to the "boiling" of the air. If astronomers could ascend five or six miles above the surface of the earth, and mount their telescopes on a reasonably steady platform, it is certain that such a device would enrich our knowledge in astronomy enormously. Of course, the Captive Heliocopter will probably not be perfected for many years to such an extent that it will be possible to actually take photographs of celestial objects while the machine is at a height of several miles. The vibration and swaying of the machine would doubtless preclude the taking of such pictures, which require a very long exposure, but for viewing celestial objects, as for instance, the moon or Mars by means of a powerful telescope and using the eye, we are quite certain that the Captive Heliocopter would prove a great boon to our astronomers.

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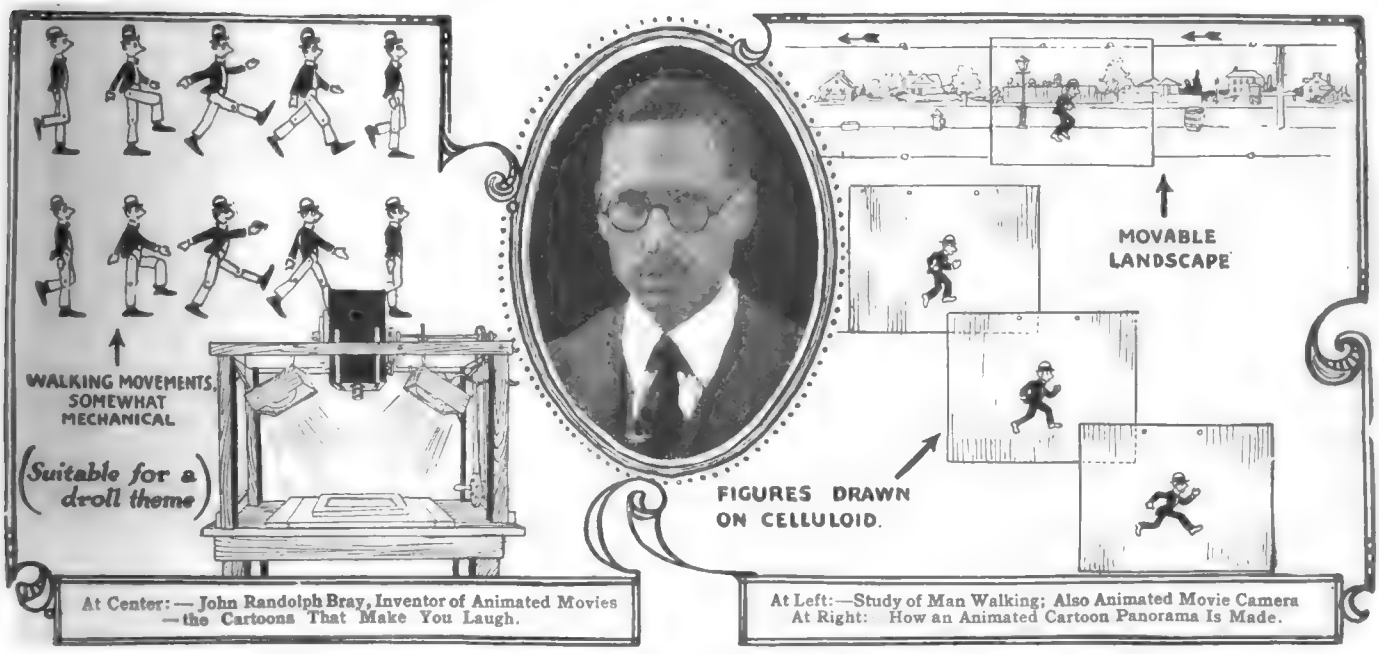
Fortunes From Little Things

By CHARLES FREDERICK CARTER

No. 4 Animated Drawings

MOTION picture devotees, meaning 'most everybody, often find their favorite diversion varied with cartoons or sectional drawings explaining the action of machines and apparatus they never understood before. These are designated by the generic term of "animated drawings."



At Center:—John Randolph Bray, Inventor of Animated Movies —the Cartoons That Make You Laugh.

At Left:—Study of Man Walking; Also Animated Movie Camera
At Right: How an Animated Cartoon Panorama Is Made.

These animated drawings are easy to look at, but difficult to produce.

Simple as they seem to be when thrown on the screen, these animated drawings played a vital part in the World War, and they are playing an ever-increasing part in education, in commerce and in industry. Without the American Expeditionary Force the Allies in all probability would have been defeated; and without animated drawings, it seems as certain as anything in this uncertain world can be, that the American Expeditionary Force could not have been trained in time to be of service.

When the United States declared war in 1917 we had no army, no military equipment, no anything. The Germans regarded us with contempt. They were sure we never could raise, equip, and train an adequate army in time to help the sorely prest Allies. And we never could have done so, if the War Department had not turned to motion pictures immediately, as the one, and only hope of expediting the training of raw levies.

Under the direction of army officers a series of ordinary motion pictures was taken to illustrate the manual of arms and the school of the company, the largest unit considered capable of presentation on the screen. But the recruits could learn nothing from these pictures. They were a total failure.

Then John Randolph Bray, inventor of the *animated drawings*, was called in to see what the trouble was. He pointed out that evolutions could not be explained by photographs alone; but by alternating them with animated drawings, to explain in detail what the movements involved, the drill would become as plain as day. A trial proved that he was right.

But drill was the easiest thing the new soldiers had to learn. War is an affair of science and mechanics. Apparatus, machines, and operations, the recruits never even heard of, had to be mastered in double quick time. Experience taught that old methods were too slow. So several of Bray's associates and assistants were sent to Fort Riley, where they photographed machine guns, grenades, motors for trucks and airplanes, road building, map reading, and all the hundreds of other things, a soldier needs to know, and explained each in animated drawings. With the aid of these combined motion pictures and animated drawings over 2,000,000 men were trained, quicker than men ever were trained before. Government officials say Bray's pictures shortened the war two months. As a matter of fact they made victory possible.

When the man who rendered his country and civilization such inestimable service was much younger than he has ever been since—he is only 42 now—he had a nice job as artist on the "Detroit Tribune" at $6.00 a week. He might still have the six dollars if he had not been so fastidious. But just because the managing editor wanted him to go to the Morgue to draw portraits of victims of accidents or violence, he threw up his job and came to New York. He found a job on the *Brooklyn Eagle* as a Cartoonist and began sending contributions to *Judge* and other publications. Soon his outside work became so much more important than his job, that he threw up the latter.

Bray might have dubbed along in respectable obscurity for the rest of his days, if he had not taken his best girl, now Mrs. Bray, to the movies. Movies were even cruder in 1907 than they are now, if that statement can be credited. Young Bray thought if he could put drawings into motion pictures it might help some. But of course the idea was absurd: anybody could have told him that: many did tell him. Figure it out for yourself: there are 16 pictures to the foot of film, 16,000 to the reel. A rapid worker might possibly make two drawings a day with a background and 7 or 8 figures in each. By working at that rate every day in the year he could make drawings enough for a single reel in 21 years, 11 months and 5 days. For four years Bray disappointed customers, and squandered savings, while he experimented with animated drawings. It got so his best friensd would greet him with:

"Well, I see you are still out of the asylum."

At last the thing was worked out and the first basic patent was issued, August 11th, 1914. Three additional basic patents have been issued since, and two of his associates have also each taken out one patent, so that the process is pretty thoroly covered. "Colonel Heeza Liar," the first animated cartoon serial, eventually found its way to every continent and the islands between. It was soon found that the cartoons went better when combined with scenic or educational features, and that is the way they have been served to the public since.

You see Bray found out, after weary months of experimenting, that it wasn't necessary to make a complete drawing for each of the slight movements to which each individual picture must be limited in order to create the illusion of motion, but that the same background may be made to serve for a number of pictures. That discovery started things off. After that many improvements were introduced to save time and labor.

The diversity of uses for animated drawings is already amazing, and there seems to be no limit for further increase. For instance the U. S. Navy Department has had a series made to explain to enlisted men the operation of the Newport Navy engine, used on open launches. The War Department, profiting by experience in the world struggle, has ordered a large number of prints from a most elaborate picture illustrating every detail of the automobile, a picture that was nearly two years in the making. This picture is also being widely used to train civil life chauffeurs.

Animated drawings make plain the operations of intricate machinery, like the adding machine, for instance. Things invisible like gases or electricity can be shown by means of symbols. They illustrate astronomy, geology, physics, botany, hygiene, biology, etc.

Bray is now President of the Bray Pictures Corporation, a concern with $1,500,000 capital, employing 60 artists in three establishments in New York and Chicago, and scores of photographers in the field.

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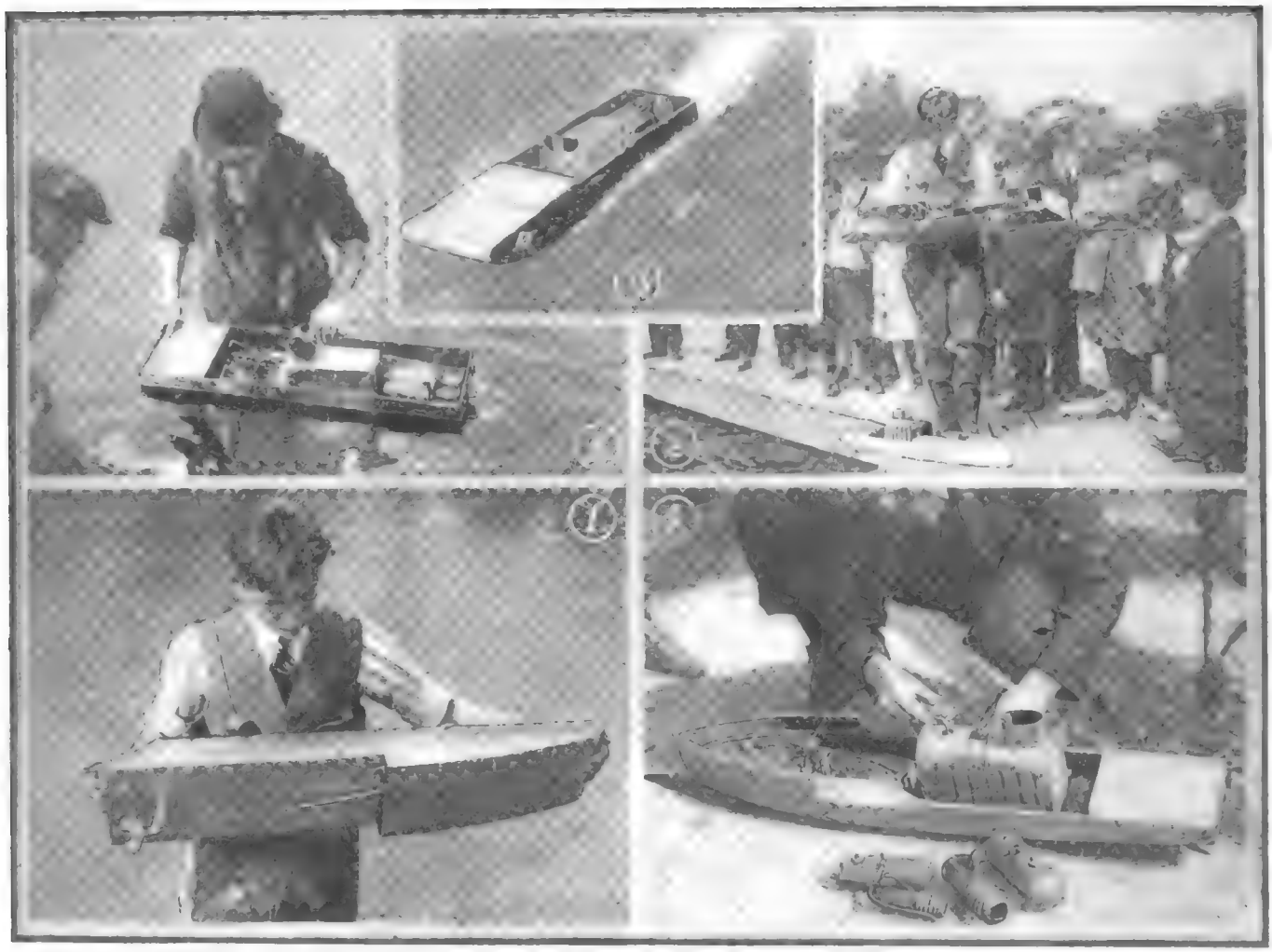
Model Boats Show Great Speed



1.—The "Elmara VI," Bottom View Showing the Step and Propeller.
2.—The "Elmara VI," Showing the Side View and Interior.
3.—The "Elmara VI," in Action, Doing Her Thirty Miles an Hour.
4.—One of the Slower Boats, the Much Admired "Apache."

5.—A Near View of the Interior of One of the Central Park (New York City) Boats. Youthful America Is Rapidly Awakening to the Fact That Real Sport Indeed Can be Had by Building and Sailing Model Launches, Such as Those Here Illustrated.

The racing of model boats has quite a group of enthusiasts in this country as well as in England. In Central Park, New York, one of the lakes is devoted to this sport and many interesting examples of the miniature craft may there be seen in motion. Of the more conventional types is the Apache. This is a steam propelled boat with a V-bottom hull and figures among the slower craft as she only makes fifteen miles an hour. When we recollect that this is the speed of a river steamer, and that it would take one to Albany in a night, it will be seen that the little boat, about a yard long, is a very respectable performer.

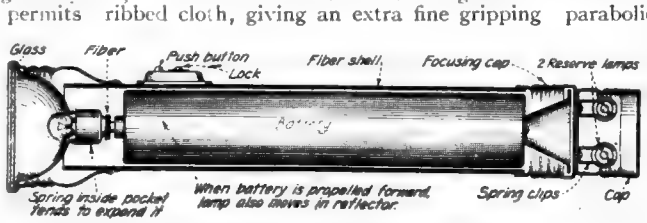
But now we come to something faster, a gasoline driven hydroplane boat 39.37 inches in length which it will be observed is one meter, with a beam of 7.7 inches, which is one-fifth the length. We show the bottom with the single propeller and very deep step.

It is hard to conceive of a boat with less model or shape, and yet this little one-meter boat, the Elmara VI by name, can make over thirty miles an hour. She is made of mahogany and aluminum with a cast aluminum propeller. Besides the two views of the boat out of the water held in the hands of her owner, one of the views shows her in motion tobogganing over the surface of the water. She is driven by a gasoline engine and is one of the fastest boats on the lake. Another craft of unknown name is also shown with her owner standing in the water alongside her. This sport has become one of the great summer diversions of youthful visitors to Central Park. This sport is found to develop fine mechanical ideas in boy's minds.

New Focusing Flashlight

The accompanying diagram shows one of the greatest advances in pocket flashlight design in a decade. Manufacturers have improved the switches, and push buttons, and numerous other adjuncts, in the realm of flashlights, but it has remained for one of the biggest American manufacturers of flashlights to bring out something really new and valuable. This flashlight permits focusing a beam of light, with a sort of micrometric screw adjustment, and not only this, but did you ever imagine yourself out camping and — bloey! Out goes your flashlight, and of course you did not bring another bulb along; and if you had ten chances to one, it would have been broken, unless you had it in a strong case or box.

So—our wide awake manufacturer has at last solved this problem, by providing a simple extra cap on the bottom of the flashlight, as shown in the diagram, which, when unscrewed, discloses two extra bulbs, which are thoroly protected against breakage, and yet are always with you. The flash light is covered with an excellent grade of ribbed cloth, giving an extra fine gripping surface, while the push button is provided with a sliding lock, so that the light can be kept burning constantly for any period desired. All the metal parts are highly polished. The focusing arrangement as the diagram shows, is effective and yet very simple, a spring holding the lamp socket and lamp, quite low in the focus of the parabolic reflector; when the screw cap at the rear of the battery is turned, the lamp and its socket are moved forward, thus altering the position of the lamp with respect to the reflector. Thus any degree of concentration in the flashlight beam can be instantly obtained. Such a flashlight should prove useful to physicians for inspecting the throat.



The Latest Novelty in Flashlights—the Reflector and Lamp Can be Focused. Two Spare Lamps are Carried in an Extra Cap.

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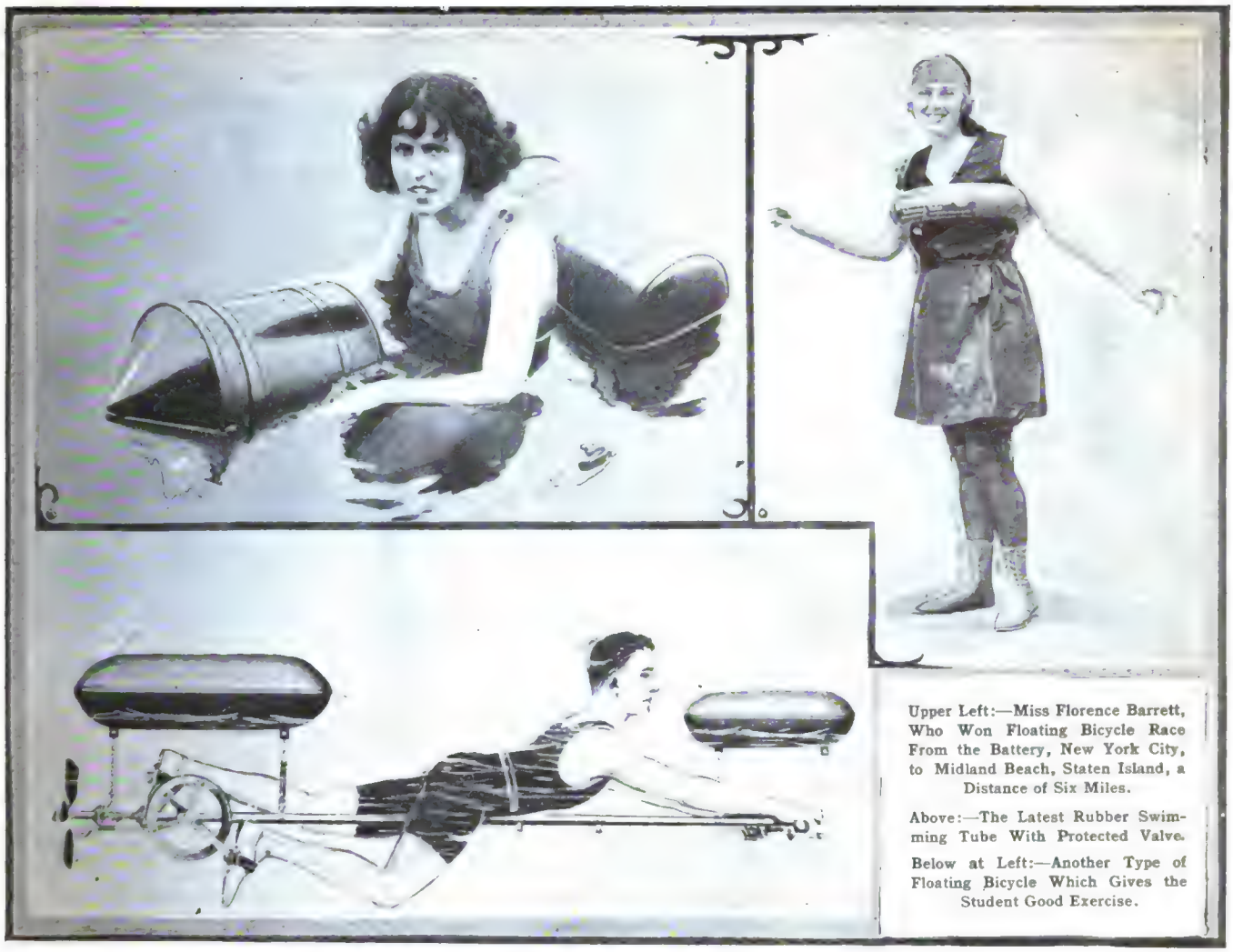

Upper Left:—Miss Florence Barrett, Who Won Floating Bicycle Race From the Battery, New York City, to Midland Beach, Staten Island, a Distance of Six Miles.

Above:—The Latest Rubber Swimming Tube With Protected Valve.

Below at Left:—Another Type of Floating Bicycle Which Gives the Student Good Exercise.

Latest Swimming Devices

One of the accompanying photos shows an interesting water bicycle fitted with pontoons, and on a model of which Miss Florence Barrett, whose likeness is here shown, recently completed a trip from the Battery, New York City, to Midland Beach, Staten Island, a distance of six miles, in record time against other competitors, for which achievement she received a medal.

The second device here shown is a new swimming tube designed by Mr. G. G. Yule. It somewhat resembles an automobile tire tube, but this device is specially made for swimming. It is furnisht in three different sizes. It is fitted with a water-proof valve and a rubber sleeve, which covers the valve so that it cannot chafe the wearer. The makers of this swimming tube state that it is not only of use to bathers and learners, but that it also will prove very useful as a life preserver for yachts and other small watercraft. It is furnished in a bright green color making it very attractive. This swimming tube will be seen in use on many of the beaches this summer.

The third photo shows another new water bicycle, which was tried out successfully a short time ago in Jersey City, N. J. The designer of this machine claims that it is very fast in the water, and that it possesses many other meritorious features. The operation of the machine is similar to that of the bicycle, it being geared for high speed. The propeller at the rear acts as the rudder, being controlled by wire cables extending from the handles. This machine, as well as the other two illustrated, should provide a lot of sport and pleasure as well as exercise for many who are afraid to venture into the water without the aid of some such buoyant device as one of those here illustrated.

Self-Contained Battery Bell

The illustrations herewith show something very useful and ingenious in electric bells and buzzers. Instead of having to run wires along and under carpets and beds, doors, etc., when a temporary circuit only is needed, and having to install a battery, one can simply lay the wire along a hall or between two rooms, when using this device, and no extra batteries or other paraphernalia is necessary. All one has to do is to push the button and the buzzer or bell, depending upon which style of instrument is used, gives the signal.

The secret of this compact design lies in the fact that a small flashlight battery is contained in the base of the bell. The apparatus is very well designed and accurately built, giving the maximum of sound for a given battery consumption. Such compact signaling devices have been awaited by the public for a long time.

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First Steam Locomotive Runs Again

Note the Striking Contrast Between the Old DeWitt Clinton Steam Engine Designed Some Ninety Years Ago, and its Train of Three Small Coaches, Standing Alongside of a Giant Steam Locomotive of the Present Day Type, Such as Used in Hauling Trains Between New York and Chicago, 900 Miles in Eighteen Hours.

Above We See the Old DeWitt Clinton Steam Locomotive and its Train of Three Small Coaches Carrying Passengers Garbed in Clothes Like Those Worn in 1831, When This Historic Train Made its Initial Trip Over the Short Stretch of Track Between Albany and Schenectady in That Year.

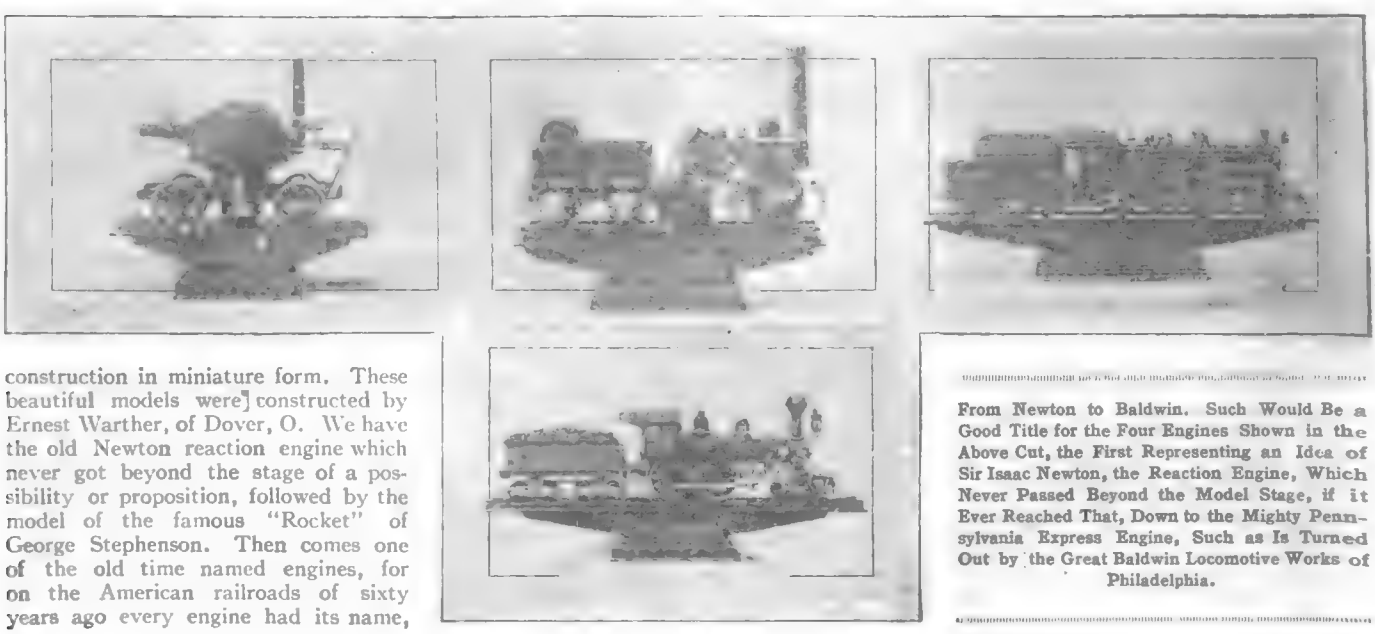
Some ninety years ago, this tiny locomotive was built in the West Point factory on the Hudson River and was shipt to Albany, where on August 3d to 9th, 1831, it made its initial trips, the last named trip with a passenger train over the short run from Albany to Schenectady. For some time past it has been on exhibition in the Grand Central station, and now it has been sent to Chicago, where a Pageant of Progress Exposition opened on August 1st. It was given a trial run under its own steam on the tracks of the New York Central Railroad along Riverside Drive, where a rehearsal, as it was termed, took place. The passenger cars, which were Concord coach bodies mounted on railroad trucks, received their passengers, some of the ladies drest in what were assumed to be the costumes of 1830. Its first load of passengers was carried from Albany to Schenectady on August 9th, 1831. It is said that they had a very uncomfortable time on account of the shower of wood sparks and cinders from the engine.

The engine has been naturally reconstructed to a considerable extent, and is not, piece for piece, the old original DeWitt Clinton. The weight of the locomotive is 9,420 pounds, the tender 5,340, each coach 3,420, the total weight being 25,020 pounds.

People of the present generation can hardly realize perhaps that it was not so many years ago when railroad locomotives burned wood instead of coal. One of the largest eastern railways burned wood about thirty-five years ago or less, and the older residents in the towns along this railroad remember very well when it was a common everyday sight to see long piles of cordwood, which had been cut and carted from the nearby forests for use on the locomotives. Looking at the picture on the right, the casual observer may not perhaps realize just how comfortable or uncomfortable these small cars really were, when it came to taking a journey of thirty to forty miles or more. The swinging cabs of these cars often made people very ill.

Wooden Models of Locomotive Engines

We feel that we are favored in being able to present our reader with illustrations of some wonderful models of locomotive engines to illustrate the evolution of their construction in miniature form. These beautiful models were constructed by Ernest Warther, of Dover, O. We have the old Newton reaction engine which never got beyond the stage of a possibility or proposition, followed by the model of the famous "Rocket" of George Stephenson. Then comes one of the old time named engines, for on the American railroads of sixty years ago every engine had its name, which was painted on the tender. Here we have the "Commodore Vanderbilt," which attained the speed of 40 miles an hour. Finally we have one of the impressive Pennsylvania express engines which can draw the heavy load of Pullmans at 80 miles an hour, with many more miles in reserve.



From Newton to Baldwin. Such Would Be a Good Title for the Four Engines Shown in the Above Cut, the First Representing an Idea of Sir Isaac Newton, the Reaction Engine, Which Never Passed Beyond the Model Stage, if it Ever Reached That, Down to the Mighty Pennsylvania Express Engine, Such as Is Turned Out by the Great Baldwin Locomotive Works of Philadelphia.

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Magnets Hold Ferry Boats in Slips

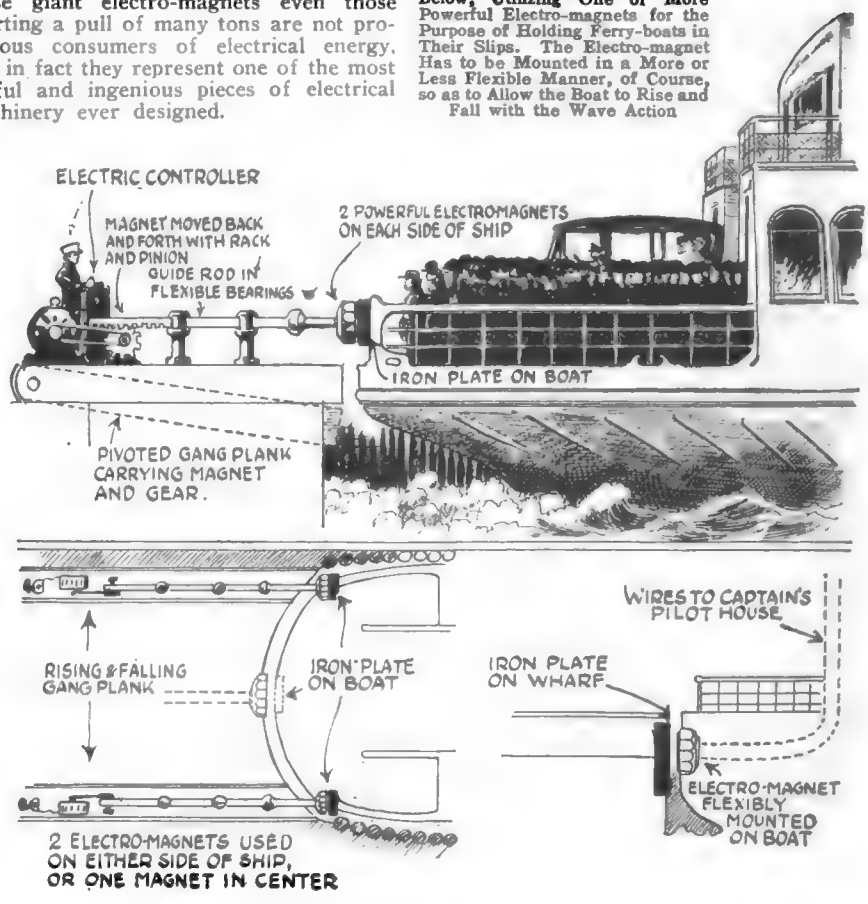
Giant electro-magnets, some of them measuring five feet or more in diameter and capable of lifting or exerting a pull of many tons, have been widely exploited all over the world for multifarious uses, but one of the most novel as well as feasible applications of the heavy duty electro-magnet, is the suggestion given herewith by Prof. T. O'Conor Sloane,—that of holding ferry-boats in slips, in place of the usual ropes and winding gears, which have been in use probably since the days of Robert Fulton. There are several suggestions possible as to the way of applying the electro-magnet or rather electro-magnets to ferry slips, as the accompanying illustrations show.

If the magnets are placed on the pier then they would, unless other provisions were made, have to be mounted on flexibly jointed rods, which can be extended possibly by an electric motor and worm gear under the control of a single operative; further, it is to be noted that as the drawing shows, the magnets and other gear, should rise and fall with the gang plank so as to bring the magnets always in line with the iron plates on the boat at different tide levels.

Another scheme as suggested by Prof. Sloane would be to place the magnet or magnets on the boat itself, so as to be under the control of the pilot, who can thus very accurately throw the current on and off at the proper moment, when the magnet on the boat and its armature on the dock are in alinement one with the other. As one of the illustrations shows, a long iron plate will be necessary where the magnet is placed on the ferry boat, so that the magnet would be sure to find a surface to hold on, as at different tide levels.

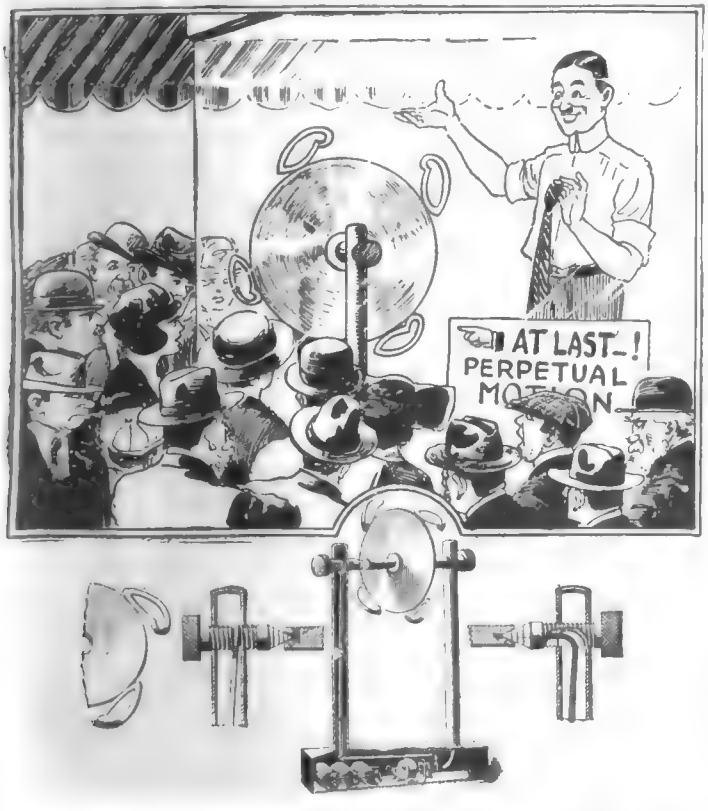
Contrary to popular opinion perhaps, these giant electro-magnets even those exerting a pull of many tons are not prodigious consumers of electrical energy, and in fact they represent one of the most useful and ingenious pieces of electrical machinery ever designed.

Several Schemes Are Illustrated Below, Utilizing One or More Powerful Electro-magnets for the Purpose of Holding Ferry-boats in Their Slips. The Electro-magnet Has to be Mounted in a More or Less Flexible Manner, of Course, so as to Allow the Boat to Rise and Fall with the Wave Action


ELECTRIC CONTROLLER
MAGNET MOVED BACK AND FORTH WITH RACK AND PINION
GUIDE ROD IN FLEXIBLE BEARINGS
2 POWERFUL ELECTRO-MAGNETS ON EACH SIDE OF SHIP
IRON PLATE ON BOAT
PIVOTED GANG PLANK CARRYING MAGNET AND GEAR.
RISING & FALLING GANG PLANK
IRON PLATE ON BOAT
WIRES TO CAPTAIN'S PILOT HOUSE
IRON PLATE ON WHARF
ELECTRO-MAGNET FLEXIBLY MOUNTED ON BOAT
2 ELECTRO-MAGNETS USED ON EITHER SIDE OF SHIP, OR ONE MAGNET IN CENTER

"Perpetual Motion" Advertising Device

PROBABLY there is no other one idea which occupies the minds of more people, particularly inventors, the world over today, than perpetual motion. It is the "everlasting will-o'-the-wisp" which the crank inventors, for many centuries, including the present one, are forever chasing. We hope that those who are particularly interested in perpetual motion will soon experience the joy of standing in front of a local store window and witness the operation of this latest marvel, a perpetually (?) rotating machine devised by one Leander Davis Wheatley,



"Perpetual Motion" Would Seem to be Solved at Last, if You Perchance Happened to See One of the Machines, Like That Shown in the Illustration, Rotating at High Speed in a Show Window. It is Not as "Perpetual" as It Looks, However, for on Close Inspection We See That a Small Electric Motor Supplies the Mechanical Driving Power to the Disc, by Means of a "Live" Shaft Center

of Pendleton, Oregon.

The editors must confess that it is one of the "slickest" schemes for advertising, and one of the finest devices for producing mysticism, even in the mind of educated people, that they have ever seen. Like many other real good things, Mr. Wheatley's invention is quite simple indeed, once you come to analyze it. On the periphery of the revolving wheel may be placed small advertising miniatures of the goods being demonstrated, but the inventor shows in his patent several glass tubes containing mercury, causing the onlookers to believe, that quite possibly this constant motion of the mercury, circulating thru the tubes, causes the wheel to rotate. The revolving wheel is mounted between two pointed bearings or pivots, which project into the conical bearings provided on the shaft at either end, as shown. One of these conical pivots is made so that only the point of it revolves, and this point is fastened to a small flexible shaft, the lower end of which is connected with a clock-work motor, this being wound when run down by an electric motor connected to an electric light circuit or other current.

The large revolving display wheel can be stopt by simply turning the screw at the side of the left-hand column, which causes the clutch in the base of the machine to be disengaged, thus stopping the flexible shaft which drives the "live" bearing cone. The display wheel can be removed and handed out to anyone for demonstration by simply turning the screw formation which throws out the clutch and at the same time increases the distance between the bearings so that the wheel can be removed. When the wheel is replaced this screw is tightened up, and automatically the clutch throws the machine into operation and away it goes again, greatly to the mysticism of the onlookers. Of course, in building this machine, the uprights are kept very small.

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Opening Safe Locks

By JACK HARTMANN

SAFE LOCK EXPERT

WHY COMBINATION LOCKS CAN'T BE OPENED BY LISTENING FOR "FALLING TUMBLERS"

AFTER reading the interesting article entitled *Electrical Marvels Startle Delegates*, in the January, 1921, issue of *Science and Invention*, I wish to take the liberty of stating that I honestly do not believe it possible to open a Safe by the method outlined therein.

For many, many years writers of fiction have taken a keen delight in digging up all kinds of *systems* for the convenience of their heroes and villains in opening Safes and Vaults and almost all of them were, and are, based on the theory that the tumblers or wheels of a Safe or Vault lock either "fall" or "slide"; when in reality they do nothing of the kind. One of our worthy writers tells us a safe may be opened by "feeling" the tumblers "fall," and that, in order to secure the extremely delicate sense of touch necessary in this "art," the finger tips are sand-papered to expose the sensitive nerves. Another tells us how to do it by placing a glass of water on *top* of the safe and watching for the wave in the glass, caused each time a tumbler "falls." Still another advocates the doctor's stethoscope, to "hear them fall." Another merely "solves" the combination. So simple!!

These systems are all right in fiction, or in the movies, for those two must be given a little rope, but the only place they will work *is* in fiction or in the movies and any safe man will tell you so—if he wants to tell the truth. But now it seems that our scientific writers have joined the merry "Safe System Society" by bringing out the "Rochelle Salt System."

Why won't it work? For the simple reason that there is absolutely nothing to *feel* or *fall* in a Safe or Vault lock. Nothing falls, drops, slides or slips, *but turns*. For the sake of explanation, suppose you were standing in front of a Safe door. On the outside of the door (see Fig. 1) is the dial ring, dial knob and dial; thru the door passes the dial spindle, and on the inside of the door, screwed to the dial spindle, is the drive wheel. The dial, dial spindle and drive wheel act as one piece, that is, when the dial is turned one complete turn the drive wheel turns one complete turn. Just behind the dial spindle and directly in line with it, is the wheel (or tumbler) spindle. The two spindles are set end to end but are not fastened together, for the dial spindle turns while the wheel spindle is stationary, being anchored by screws to the back of the lock box. The tumblers, which are discs or large "washers" (call 'em what you will) are about $2\frac{3}{8}$" in diameter, and about $\frac{5}{32}$" thick. Each wheel (or tumbler) including the drive wheel, has a slot in it. These slots are just a trifle wider than the thickness of the lock dog, which enters them when all the slots are in line (combination set). All of the wheels, except the drive wheel, are carried on the stationary wheel spindle which stands at 90 degrees with the bolt bar, J. All of the wheels are a certain distance apart (separated by small washers) so that the screw or lug (according to make of lock) near the outer edge of one wheel will strike the screw or lug in the wheel next to it. In this way the motion of the dial is carried to all of the wheels. There are two screws or lugs in each wheel, except in the drive wheel and in the last wheel, which have only one each.

Now let us follow the train of motion of a Hall lock which has 3 tumblers on the stationary or tumbler spindle, remembering that the tumbler farthermost from the drive wheel is No. 1, the second one from it is No. 2 and the one next to it is No. 3; (see Fig. 1). Suppose the combination is:

Turn Right until 10 comes to mark 4 times
" Left " 20 " " " 3 "
" Right " 30 " " " 2 "
" Left " 40 " " " 1 time

When the dial is turned to the Right the *first* time (see Fig. 1) only the drive wheel turns; as it is given the *second* complete turn the screw head in the back side of the drive wheel strikes the screw head in the front side of the tumbler next to it (No. 3). When it is given the *third* turn to the right the screw head in the back side of the tumbler next to it (No. 3) strikes the screw head in the front side of the second tumbler from the drive wheel (No. 2). When given the *fourth* (and last) turn to the right the screw head in the back side of the second tumbler from the drive wheel (No. 2) strikes the screw head in the front side of the third tumbler from the drive wheel (No. 1). Now all of the "play" or lost motion is taken up and if the dial is turned to the right again all of the tumblers move with it. This is the first step in opening any safe and in Safe work is called "dragging."

As we have turned 4 or more times to the Right the dial is stopped when 10 comes to the mark (the first part of the combination). The next part is Left until 20 comes to the mark three times. The *first* time the dial is turned to the left only the drive wheel turns. When given the *second* turn to the left the dial has been turned twice and the third tumbler once. When the dial is turned to the left the *third* (and last) time the dial has been turned to the left three times, the third tumbler twice and

(*Continued on page* 482)

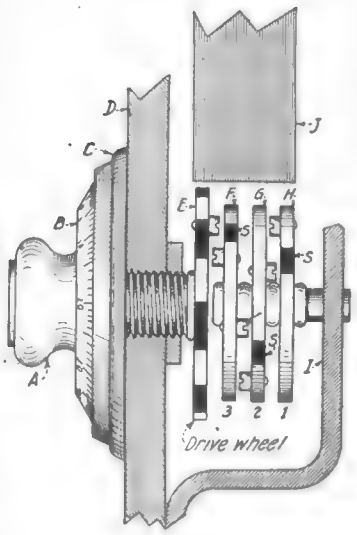
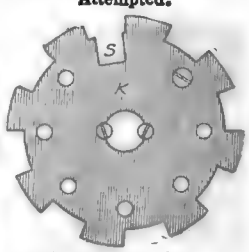


Fig. 1. Typical Combination Safe Lock. Drive Wheel (E & K) is larger in diameter Than Tumblers (F, G, H), to Prevent "Feeling" the Tumblers With Lock Dog (J). Also Has Projections on Outer Edge to Catch Dog (Locking Dial) if This Is Attempted.



Dial Knob (A); Dial (B); Dial Ring (C); Door (D); Drive Wheel (E & K); Tumblers (F, G, H); Back of Lock Box (I); Lock Dog (Part of Bolt Bar) (J); Slots in Tumblers; and Drive Wheel (S).

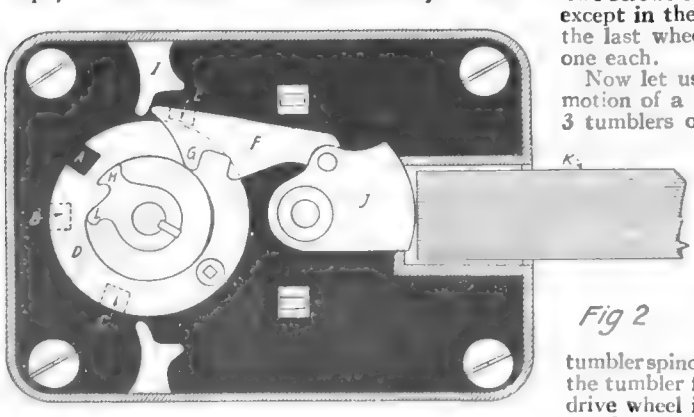


Fig 2

Rear View of Direct Shaft Combination Lock. Why the Tumblers Cannot Be Heard to "Fall" Is Fully Explained by the Author.

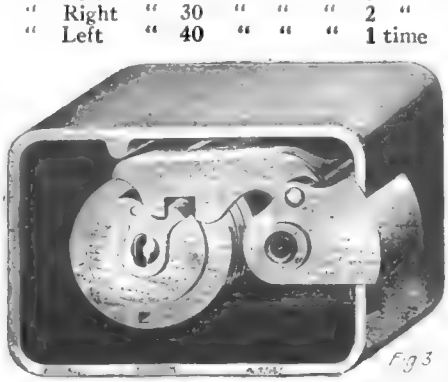


Fig 3

This Shows a Safe Lock Operating on the Same Principle as the One at Fig. 2.

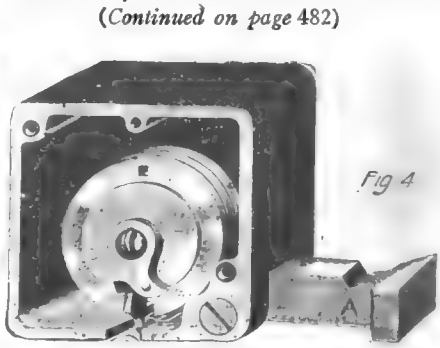


Fig 4

Same Make of Lock as in Fig. 3, Lock Dog Entering from the Bottom Instead of from the Top. Both Are "Direct Shaft" Locks.

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Latest Automobile Devices

A MOTOR CYCLE AMBULANCE

When the side-car was first introduced as an adjunct of the motorcycle, it met with a certain degree of opprobrium. It was sometimes termed a *bathtub*, and one of the sights used to be a man, his wife and a couple of children speeding along in one of these wonderfully convenient combinations

View of the Latest Motorcycle Ambulance Showing How It Receives and Accommodates a Patient; the Top Is Thrown Back So As to Expose the Interior, Indicating How Readily the Patient Can Be Transferred in and out of the Comfortable Looking Body.

of motorcycle and side car. In one way it constitutes much better mechanics than the giant limousine, for its ratio of idle weight to the weight transported, is unusually advantageous. When the side car was introduced into the service of the army, and was used by the commissioned officers in their military functions, it won the respect to which it had long been entitled, and lately it has been adopted by the police. Our cuts show a most interesting application of the motorcycle and side-car to Red Cross work in the widest sense. An especially long side car with adequate cover and proper arrangements and appliances forms a wonderfully efficient ambulance, which can carry the patient and surgeon from the scene of accident or injury to the hospital. These photographs come from Melbourne, Australia, and indicate that the inhabitants of the antipodes are thoroly up to-date or perhaps are a bit in advance of the natives in the older countries.—*Photo courtesy Harley-Davidson Motor Co.*

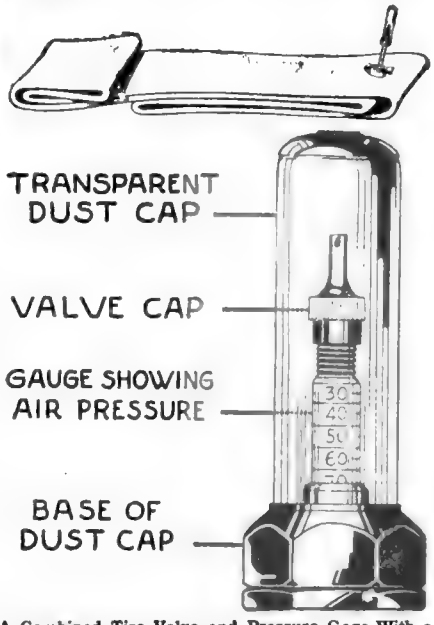
"RIGHT," "LEFT" or "STOP" FLASHES NEW AUTO SIGNAL

This new auto signal is designed to be put on the rear of an automobile and is connected to the battery and contains a lamp. When the car is to be stopt the foot brake is naturally put on, and the least depression of the brake pedal closes the circuit and lights the lamp as shown in the cut. The lighting of the lamp causes the word STOP to flash out in vivid illumination, so that following cars know that the driver proposes to bring his car to rest. Among the details of this construction are included a reflector back of the lamp.

A Safety Indicator to Be Placed On the Mudguard or Elsewhere in the Rear of an Automobile to Indicate to Those Following, When the Driver Proposes to Stop or to Reduce Speed.

COMBINED TIRE VALVE AND PRESSURE GAGE

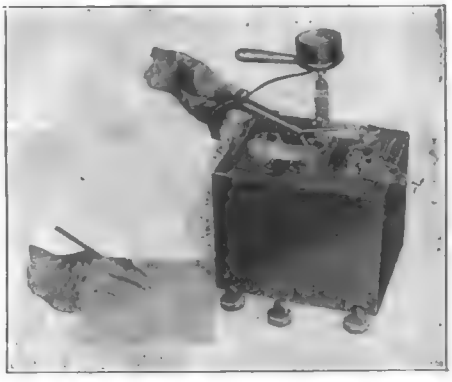
It is quite essential in good automobile practise to watch the pressure in the tires. The very neat appliance we illustrate is a combined valve and pressure gage. As the tire is pumped up the pressure is shown upon the valve stem. In the illustration a pressure of about 70 pounds is indicated. The effect of this apparatus is that it not only guides one while inflating the tire, but enables one to keep a constant eye on its air pressure. If a tire is very weak it may be desirable to run at only 30 or 40 pounds pressure, while a new tire may need 80 or 90 pounds. All this is taken care of by the valve gage that we describe. A very nice feature of it and an essential one is the transparent dust cap, because with it the air pressure can be read without removing any part.



A Combined Tire Valve and Pressure Gage With a Transparent Dust Cap; a Glance Tells You the Condition of Your Tire as Regards Wind Supply.

CADMIUM AND VOLTAGE TESTER FOR STORAGE BATTERIES

The tendency of users of storage batteries, whose number is increasing day by day, is to take more intelligent care of batteries than has been done in the past. In the apparatus we illustrate, provision is made for testing a battery intelligently. By the well-known cadmium test the voltage of each cell is individually determined and the work done by positive and negative plates is differentiated. Thus a defect in a single plate may be quickly located and the battery saved from injury. The cadmium test has long been known, but perhaps not so well as the voltmeter test. This apparatus supplies both in one, so with this appliance in hand there is no excuse for not knowing the exact state of the storage battery. The simple hydrometer test of battery solution can no longer be accepted as adequate. The apparatus is fitted with a cadmium electrode.



An Apparatus for Applying the Cadmium Test and for Obtaining Volt-meter Readings from a Storage Battery, so as to Watch Its Condition and Detect Weak Positive or Negative Plates.

BATTERY CHARGING OUTFIT

Here is a small portable battery-charging outfit recently placed on the market. It provides a foolproof means for charging automobile batteries, from an ordinary alternating-current house-lighting circuit, without the necessity of taking the car to a public garage or charging station.

Provided with a flexible extension cord and plug, it can be connected to any lamp socket. The direct-current leads are equipped with special clips for connection to the battery. The charger is rugged, reliable and of simple construction. It has no moving parts; uses no oil or grease, and is not affected by heat or cold. All parts are supported from the circular cast iron base and are enclosed by a metal cover which is attached to the base by three screws. The top of the cover is shaped into a handle for easy carrying.

The principal parts of the outfit are a transformer, and a rectifier bulb. The transformer is mounted vertically on the base. A fuse for protecting the apparatus is located on a small insulating block at the top of the transformer. The bulb is mounted in a socket, which is also on the base in front of the transformer. The insulation of the bulb is simple, being screwed into the socket like a lamp and a wire lead clipt on the terminal projecting from the top.

These Charging Outfits Are So Designed as to Give Rated Amperage at Normal Line Voltage to Three Cells and About Two-thirds This Current at Normal Line Voltage to Six Cells. They Are Furnished in Two Sizes, One with a D. C. Rating of 2½ to 1¼ Amperes and a Larger Size with A.C. Rating of Three to Six Amperes

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How Much Horse-Power Do You Develop?

By JACQUES BOYER

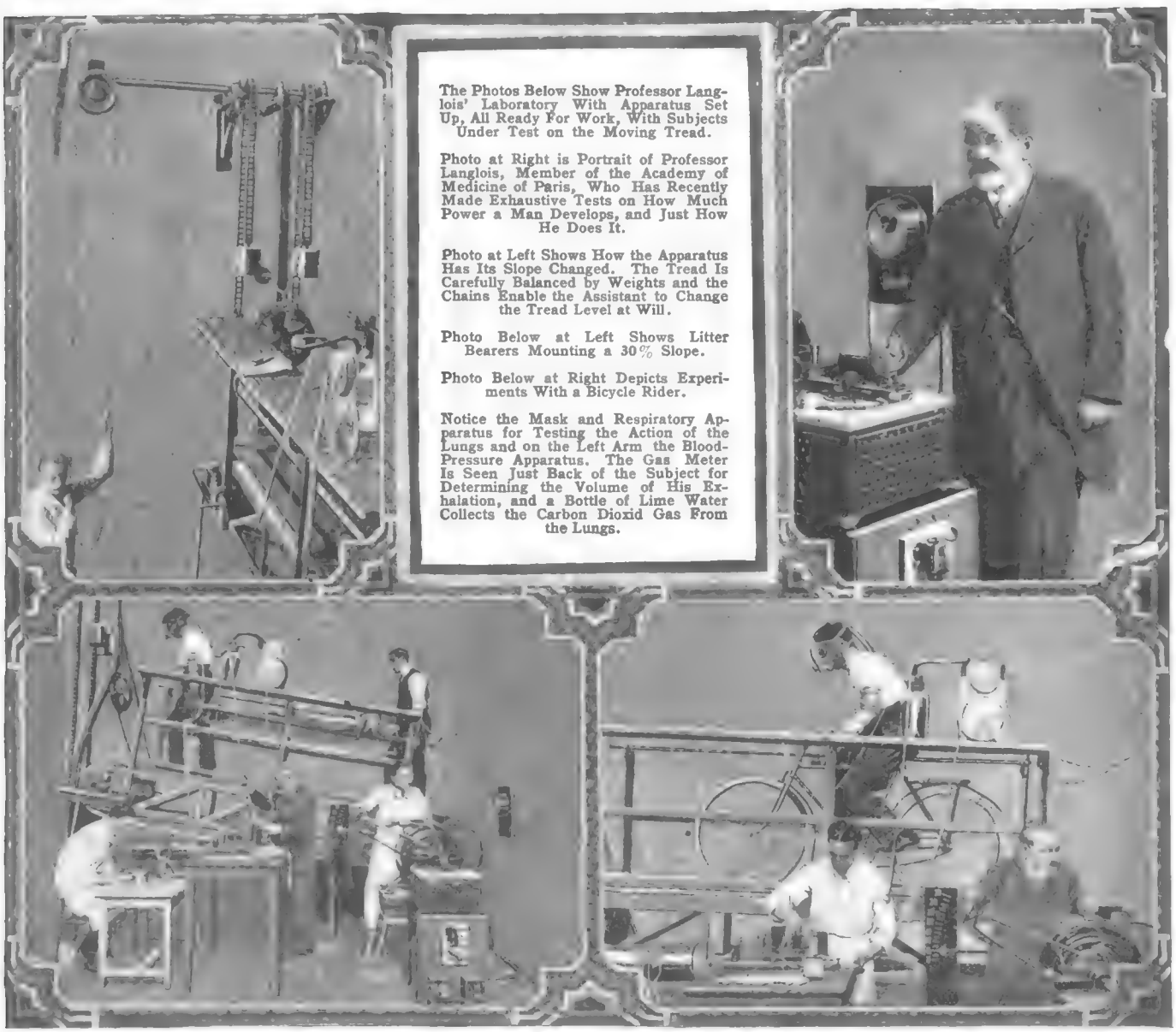
Prof. Langlois' Study of the Work of Man in Motion

THE traveling carpet, which Professor J. T. Langlois, member of the *Academy of Medicine of Paris*, has set up in his laboratory, is a development of the moving walk constructed by the physiologist, Dr. Benedict of Washington, for studying the same topics. But while the apparatus of the American scientist only permitted the making of relative measurements of horizontal progress with speed not exceeding four and a quarter miles an hour, the new installation while it is less cumbrous, works at speeds varying from a mile and a quarter to 16 miles an hour and can be moved as desired, so as to study a man ascending or descending an incline varying from zero to over 25%.

The new apparatus of Professor Langlois consists of an endless leather carpet or belt drawn by an electric motor, similar to the escalators in the department stores, but with this difference; that the carpet moves in the direction the reverse of the man's motion. The arrangement is not to help his progression, but to keep him in one place while he does move, whether on a bicycle, pushing a wheelbarrow, or carrying a man on his back, for example. The total length of the carpet, or perhaps we should call it a belt or tread, is 25 feet, its width is 2 feet, and it is kept in tension by two wooden pulleys, one keyed to its shaft and the other running idle. As the length utilizable for experiments is about 18 feet, two men can walk upon it carrying a litter, for example. The experimenter or his assistant controls the tension of the belt by means of two screws which act upon the axle of the idle pulley to vary its distance from the other one. Between these two pulleys the belt slides over an oak floor, carefully polisht, which takes the place of the tubular steel rollers of Dr. Benedict's apparatus.

The whole apparatus is carried by a solid iron frame and the fixt pulley is keyed upon a shaft turned by an electric motor, the shaft being geared down to reduce the speed. The whole apparatus can oscillate around this shaft when the other extremity of the frame is raised. The elevating arrangements are very simple. The end is raised by two strong chains attached to its extremity and passing over sprockets on a shaft, whose bearings are built into the wall of the laboratory 10 feet from the floor. At the end of each chain there is a counterpoise of about 175 pounds, which balances in part the weight of the apparatus raised. The force of the electric motor doing the work is five horse-power, and as Professor Langlois had at his disposal a monophase current, he had to have recourse to shifting the brushes to obtain the variations in speed required for his experiments. With these special arrangements, it is possible to start at high speed and then to gradually reduce to the speed desired. In order that the subject of the experiment shall not move, except when the belt has attained the proper rate, two little benches are provided at the right and left of the belt on which the subject can

(*Continued on page* 459)



The Photos Below Show Professor Langlois' Laboratory With Apparatus Set Up, All Ready For Work, With Subjects Under Test on the Moving Tread.

Photo at Right is Portrait of Professor Langlois, Member of the Academy of Medicine of Paris, Who Has Recently Made Exhaustive Tests on How Much Power a Man Develops, and Just How He Does It.

Photo at Left Shows How the Apparatus Has Its Slope Changed. The Tread Is Carefully Balanced by Weights and the Chains Enable the Assistant to Change the Tread Level at Will.

Photo Below at Left Shows Litter Bearers Mounting a 30% Slope.

Photo Below at Right Depicts Experiments With a Bicycle Rider.

Notice the Mask and Respiratory Apparatus for Testing the Action of the Lungs and on the Left Arm the Blood-Pressure Apparatus. The Gas Meter Is Seen Just Back of the Subject for Determining the Volume of His Exhalation, and a Bottle of Lime Water Collects the Carbon Dioxid Gas From the Lungs.

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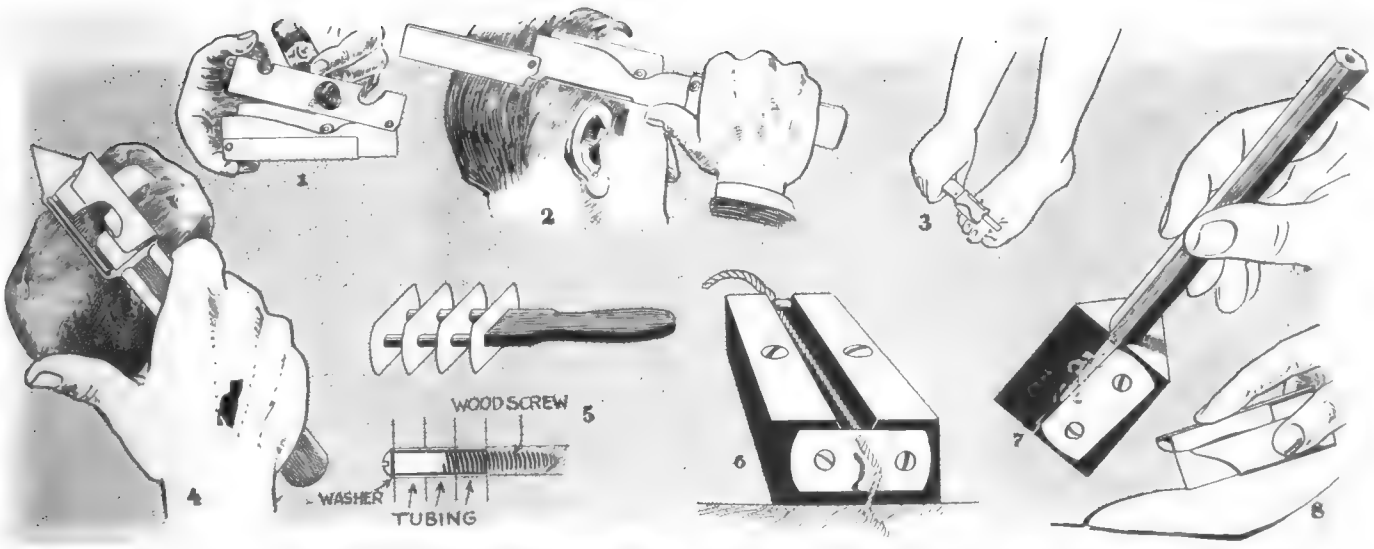

1, 2 and 3.—Here is a French Novelty in Pocket Knives Which Employs for the Cutting Blade a Discarded Gillette Safety Razor Blade. This Clever Blade Holder Folds Up, so as to Entirely Enclose the Blade When Not in Use. It Serves Also as a First-Class Cigar Cutter, Hair-Cutter, Paring Knife, et cetera. 4.—This Gives the Housekeeper an Unexcelled Paring Knife for the Kitchen. It Will Peel Potatoes, Apples, and Other Fruits and Vegetables. 5.—Whenever You Have to Cut a Lot of Short Pieces of Rubber or Other Tubing, or if You Desire to Cut Up Macaroni in Short Pieces, You Will Find This Multiple Razor Blade Chopper a Very Excellent Device. 6.—Here is a Fine Cord and Twine Cutter Made From an Old Razor Blade. 7.—Here is a Pencil Sharpener Which Would Warrant Manufacturing for the Market; the Purchaser to Attach Old Razor Blades By Means of Thumbscrews, or Otherwise. 8.—A Tailor's Knife Which is Obtainable in Most Hardware Stores.

Old Razor Blade Contest

By H. GERNSBACK

THE other morning after shaving, we threw away a safety razor blade which had done valiant service by our wire whiskers, and as we did so, we could not help reflecting how many other gentlemen that morning were throwing away similar razor blades. We estimated that the figure would probably run into half a million at least. Being of a statistical turn of mind, we had just begun to figure out how much in dollars and cents this throwing away of razor blades amounted to, how many tons of steel they totaled to and if melted down into a steel wire of the usual telegraph variety, how many times such a wire would stretch from the earth to the moon and back. Just then our "thought express" jumped the track and led us into another channel which worked thusly:

Instead of throwing away these razor blades, suppose someone would find a good use for them. Right away our statistical efforts vanished away into nothingness at this tremendous idea, and we got so excited that we had to sit down for a few minutes to try and figure out just what could be done with safety razor blades. Now let's see.

To begin with a safety razor blade is made of steel. Its business end is very sharp as is well known, and besides slaughtering wiry beards, it might conceivably be used for cutting other less harmless and less disfiguring scenery than the average man's map.

We recollect that the other day we had brought home to mother from a hardware store—at an expense of 25 cents—a new potato peeler as shown in Fig. 4, which uses a safety razor blade. And you may believe us when we say that it works splendidly. Not only does it take off the very thin skin of the potato, but you can use it for peeling apples, peaches and other fruit.

We also remembered that not so many years ago we took a piece of wood and fashioned from it a serviceable pencil-sharpener, as shown in illustration 7. Some years ago in one of our factories, the problem came up regarding the cutting of certain rubber into strips one-quarter of an inch wide. The problem was solved by making a rig illustrated in Fig. 5. A number of Gillette blades were bolted together as shown, and each cut with the multiple blades give us about ten of the rubber pieces, while heretofore, the use of a knife gave us only one strip at a time.

First Prize	**$50.00**
Second Prize	**25.00**
Third Prize	**15.00**
Fourth Prize	**10.00**

The other day we stept into a hardware store and we found that one of the clerks had arranged a razor blade as shown in Fig. 6. It will be seen that the blade is protected and no one could easily come to harm by accidentally touching it. Nevertheless it cuts all the wrapping string for the clerk simply by passing the string across the blade as shown. A very simple arrangement—cheap as it is good.

These are only a few instances of what can be done with razor blades. There must be several thousand more good ones, and much better ones than those which we illustrated here. It would seem that our readers should be able to evolve many new uses to which they can be applied, not only in the home but in the factory, and for that matter almost anywhere.

And our readers should not forget that in publishing their idea in this magazine, it gives them first rights, for if some manufacturer thinks well of a certain device, and thinks well enough of it to manufacture it, the originator can always take out a patent, and have little fear that he will not get due protection because there is nothing better than publishing an idea in a magazine of national circulation, which is considered as an authentic record by the patent office.

While it is not absolutely necessary that a model be submitted with your entry, we venture to say that the judges would rather see a model, as it is often simpler to appraise an idea this way. In all events, a complete sketch must be furnished by the contestant. No manuscript in this contest can be returned. The publishers reserve to themselves the right to publish all worthy ideas, which did not win a prize by paying regular space rates. Use only one side of the paper for writing and copy sketches on a separate sheet. No penciled matter can be considered. More than one idea may be entered by a contestant. The contest is open to everyone whether he be a subscriber or not. All prizes will be paid upon publication. This contest closes at noon, September 30th, New York, and all entries must be in by that time in order to qualify. Should two contestants submit the same idea, the same prize will be paid to both. Addresss all communications to *Editor Razor Blade Contest*, care of this publication.

French Airman Climbs 34,768 Feet

The airplane height record made at Dayton, Ohio, on February 27, 1920, by Major Schroeder, was beaten in France recently by a French airman, Lieutenant Georges Kirsch. Unfortunately, however, the Frenchman's record cannot be accepted officially, as he was forced to make a landing at another point than the one from which he started. His barometric register, when he landed showed that he had risen to a height of 10,600 meters (about 34,768 feet), which is 500 meters above Major Schroeder's record, which still stands as official.

The attempt was the ninth which Lieut. Kirsch has made, but on former occasions he has never been able to get much beyond 9,000 meters. Today he profited by previous lessons, and when he reached the 7,000 meter mark he took the climb more slowly than in earlier flights, and got safely through the change of temperature zone into rarefied air without mishap.

When he decided to descend, his 300 horse-power motor was still working well, but on the descent a stoppage in his carburetor occurred which compelled him to volplane to the nearest airdrome instead of landing, as required by the rules, at the airdrome from which he started.

The initial calculation of the height attained by Major Schroeder in his flight at McCook Field on February 27, 1920, was 36,020 feet; but after a careful homologation of his records the Bureau of Standards reduced this to 33,000 feet.

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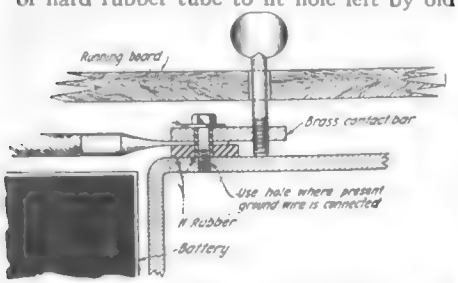
MOTOR HINTS

First Prize, $25.00.

SECRET BATTERY SWITCH

I am submitting herewith a sketch of a small inexpensive device to protect a car from thieves, which I am now using on my car. Below you will find a brief description.

The idea of this device is to break the ground connection of battery. To install it, all that is necessary is to disconnect ground wire and secure a screw and a piece of hard rubber tube to fit hole left by old



This Secret Switch which Opens the Main Battery Ground Circuit Can Be Installed in a Number of Different Ways and Should Prove a Very Good Protection if Constructed and Installed Ingeniously, So as to Defy Ordinary Detection. The Head of the Contact Screw Can Be Made in the Form of a Bolt or Rivet Head.

connection, also a piece of ½" thick brass and insulate from frame with sheet hard rubber. A brass thumb screw, long enough to extend thru the running board, completes this device.

When you tighten down the thumb screw you make ground connection and car is ready to run. When car is standing, loosen thumb screw a turn or two and the circuit is broken. The screw is best disguised as a phoney bolt, so as to defy detection.

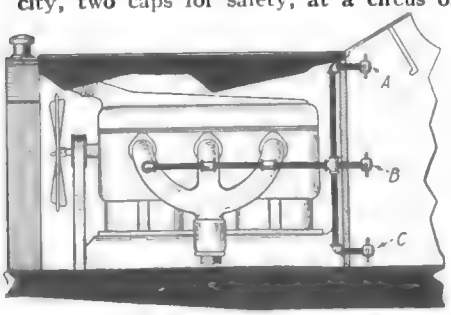
Contributed by ALBERT J. WIRSING.

Second Prize, $15.00.

EXCESSIVE AIR IN MANIFOLD FOILS THIEVES.

Note position of *intake manifold* and case-hardened steel tubing or piping ⅜" in size leading from each intake pipe where it is joined—to cross steel bracing. Here the pipe leads both downward and upward. The top section protrudes thru steel sheet and under instrument board if desired, out of sight or hidden. On its end will be seen a screw cap with steel pins thru the same for turning and removing which is shown at (A). At (B), is shown a second pipe end fitted with cap and covered with hinged ornamental cover. At letter (C), is shown a third pipe end leading lower down, securely hidden away by a cover on a hinge as desired.

These pipe ends may lead to any secret place within reach of the driver. Further, any one cap removed on driver leaving Car and placed in a pocket, will let into manifold intake an excessive stream of air, which will kill the motor at once. When at home remove one cap. When in the city, two caps for safety; at a circus or



Mr. Leibe Has Brought Out a New Line of Attack in His Excessive Air Scheme, Which if Cleverly Installed, Will Make it "Some" Job for the Would-be Thief to Start the Car and Get Away With it.

NOTICE—CONTRIBUTORS ! ! !

We have not been at all satisfied with the class of suggestions we have been receiving lately in this department. Most of the devices that are suggested are very crude, and while some of them may be original, they are so impractical that not one in a hundred motorists would think of using or installing such a device. There is, however, one device that is needed badly which apparently has as yet not been invented. We refer to a device that would prevent stealing of motor cars. In the City of New York alone, there are stolen every day an average of 15 cars. The average for the entire country varies from between two to three hundred cars each and every day. This is a terrible loss and must be stopt at all cost.

For the next few months we will, therefore, gve prizes only to such devices as prevent stealing of cars. We have publisht a few good ones in the past, but we feel sure that there are a good many others that should prevent thefts. It should be remembered always that motorists do not wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used. Variations of the device should be possible so that even after publishing such a device and giving it the fullest publicity, still it could be attached in such a way as to defy detection by the average man.—Editor.

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

large crowds, all three caps, making it a network of locks.

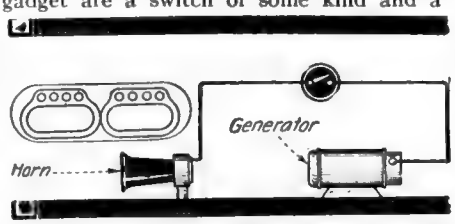
If desired, a pipe line may be run under car to back seat, under carpet of floor, to any unlooked for place. The case hardened pipe cannot be hack-sawn off, or removed quickly enough for a quick theft

Contributed by R. C. LEIBE.

Third Prize, $10.00.

HORN SOUNDS WHEN ENGINE STARTS.

The only articles required to make this gadget are a switch of some kind and a



Another Electric Horn Alarm Which Starts Sounding as Soon as the Engine is Started, the Circuit Thru the Horn Being Opened or Closed by a Well-Concealed Switch. This Scheme is Also Adaptable to Fords, as the Author Explains.

few feet of insulated copper wire. When leaving your car, close the switch shown which should be concealed in any convenient place, as on the under side of the cowl, or in the rear of the car, or wherever the ingenuity of the owner may suggest.

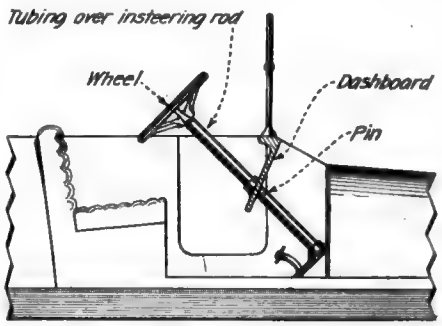
When the would-be thief starts your motor the generator creates a current which is conducted along the wire to the horn, thus blowing it. If your car is a Ford, the wire should be connected to the magneto-plug instead of to the generator. It will continue to give warning until either the engine is stopt or the alarm switch is opened.

If the burglar is a wise one he will shut off the power and make his escape if he can. The contributor has successfully installed the alarm described above on an Overland Touring car and also on a Ford.

Contributed by CARLTON BRYANT.

STEERING COLUMN LOCK.

Drill a three-sixteenth of an inch hole thru the tubing and half way thru the steering rod where the steering column goes under the dash board. Then get a hard steel pin, and paint it the color of the steering column, and round off the head of



In This Steering Column Locking Scheme the Author Suggests That a Hole be Drilled Thru the Column Which Will Accomodate a Hard Steel Pin. This Pin Can be Placed in the Hole When You Leave the Car, the Hole Being Drilled in Such a Position That the Front Wheels are Turned Well to the Side.

the pin so it will look like a rivet. Before you drill the hole turn the wheels around as far as they will go, so when you park the car turn the wheels toward the curb and insert the pin. When you are using the car take the pin out. When you take the pin out or put it in find some excuse to reach under the dash board so if a thief is looking he won't suspect a trick.

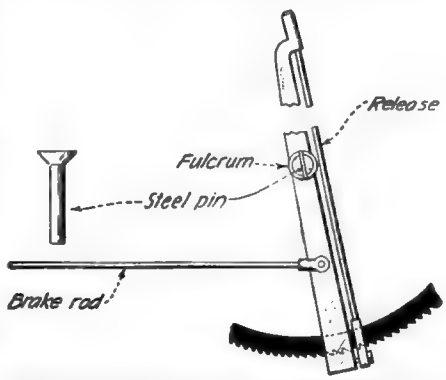
Contributed by LANDON COVINGTON.

EMERGENCY BRAKE LOCK.

Obviously the simplest way to keep a car from being stolen is to employ some sure means of locking the rear wheels so that they will not turn. It is, of course, best to use a means that is not noticeable.

When cars are left standing at the curb it is customary to pull up the emergency brake. A way to lock this brake in such a position, providing of course that the brake holds well, is a simple solution to the problem.

Referring to the diagram, a hole about ⅜" in diameter bored thru the axle or fucrum of the brake, and counter-sunk a small distance should be made. A steel pin so made that it would just nicely fit in this hole would effectually stop any attempt to release the brake, and would not be noticeable at all. Such a hole would not weaken the brake in any way. If the fulcrum of the lever is below the floor of the car I would suggest that a small well-fitted trap door be made directly over the said fulcrum, so as to facilitate getting at it. Contributedby ROBERT BROCK.



Locking the Emergency Brake Lever, by Means of a Steel Pin Past Thru the Hub and Stud on Which the Brake Lever Turns.

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Editor's Mail Bag

HE DIDN'T GET IT

Editor SCIENCE & INVENTION:

For a number of years past the firm with which I am associated as head of the Department of Photography has concerned itself in no slight degree with the adaptation of Stereoscopy to both moving and "still" work and has overlooked no principle that bore promise of practical application to the matter in hand.

Hence it was with some interest that I read the article contributed by Dr. E. Bade in a recent number of SCIENCE & INVENTION. This interest, however, was not stimulated so much by the claims made by the author as by the reputation behind your publication, which in this instance was sufficient grounds for the construction of the described apparatus, the basic principles of which appeared, to say the least, absurd.

Either the author has never observed the true stereoscopic phenomenon as produced by means of the twin lens camera (or the effects by similar adaptations) or is the possessor of a highly enriched imagination with which the ordinary individual is not gifted. His apparatus is undeniably "simple" but it is *not* a stereoscope. For the information of Dr. Bade as well as others who may be interested I offer the statement that a stereoscopic effect cannot be produced by monocular vision, a fact doubtless realized by the Creator when in His infinite wisdom he gave us two eyes instead of one.

When a "How-To-Make" article is presented to your readers some means should be employed to determine its practicability unless the contribution is offered admittedly as experimental and no other claims made for it.

ALVIN WYCKOFF,
Director of Photography
Famous Players,
Lasky Corporation.

Hollywood, Cal.

(Concerning the article entitled "How To Make A Simple Stereoscope," by Dr. E. Bade, which appeared in the Oct. number of SCIENCE & INVENTION, *we give herewith reply as quoted from Dr. Bade's letter with reference to criticism.*

"I doubt if you have tried to make the instrument referred to. If you had made it and had placed pictures or prints from postals or photos taken from magazines, you would have had a different idea of the subject. To illustrate this, take any photo, hold it in the left hand, and hold the right hand to the eye curving the fingers so that a cylinder is formed. Now look at the photo thru this eye and you will see the picture stand out.

"Another thing: In order to find flaws in a drawn or painted picture, the artist takes a mirror, turns his back to the picture, and, holding the mirror at an angle, looks thru it to the picture. Here the artist detects errors which he otherwise would not see. Therefore since both these principles are taken advantage of, a photo having depth, as almost all postal cards taken from photos and showing scenes, do, will appear to stand out in relief, in spite of the laws of optics quoted.

"Please remember this: MAKE IT, TRY IT, AND THEN CRITICISE."

—EDITOR.)

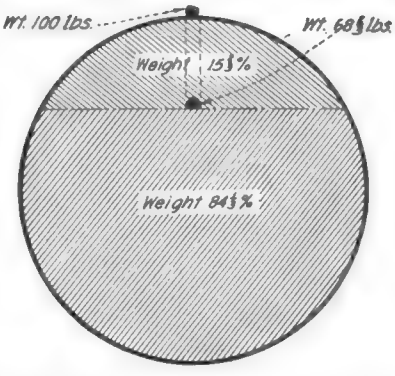
GRAVITATIONAL ATTRACTION

Editor SCIENCE & INVENTION:

Observing your statement in April number of SCIENCE & INVENTION that a ball weighing 100 lbs. at the surface of the earth would weigh 50 lbs. if half way to the earth's center. I desire to offer a friendly contradiction.

It is too commonly taught that gravitational attraction at the earth's center is nil. It would be as correct to say that atmospheric pressure at the earth's surface is nil when equalized from within and without.

Gravitational attraction at the earth's center is not nullified but is merely equalized



The Diagram Illustrates the Contributors Idea of the Difference in Weight of an Iron Ball or Other Mass at the Surface of the Earth, and at a Point One-half Way to the Earth's Center, That is One-half the Earth's Radius.

because of an equal attraction from an equal mass in every direction.

In case, however, of a body existent half way to the earth's center, gravitational attraction would not be half neutralized. As shown in enclosed rough sketch the mass below would be approximately 84⅔% of the earth's total mass, and the mass above only 15⅓%. Thus, an object weighing 100 lbs. at the surface of the earth would weigh, at a point half way to the earth's center, 68⅔ lbs.

This is only approximate as I am considering only the mass totals and disregarding any "side pull" from such portion of the mass at either side of, and on a level with, the object whose weight is considered.

Respectfully,
GEO. H. LEE.

Omaha, Nebr.

(You omit in your communication all consideration of the distance from the object acted on by segments of the earth to the center of gravity of such segments. Then applying the law of the inverse squares, you will find that your calculation is incomplete.

—EDITOR.)

WE invite our readers to use these columns for discussion on all subjects of interest to them. We aim to make this page an exchange place for ideas and invite discussion. As hundreds of letters are received weekly, it is manifestly impossible to publish all of them, and we aim to publish only the more interesting ones. Try to keep your communication within two hundred words, and use only one side of the paper when writing. It is not possible to answer communications addressed to this department by mail due to the great influx of communications received.

—EDITOR.

WHY HE READS S. & I.

Editor SCIENCE & INVENTION:

The lordly attitude of the various and sundry folk who go to the infinite pains of informing you that you're running a kid's publication affords me much amusement.

The chaps who assume a high-brow, deeply scientific air and desire you to bore 180,000 readers to death for the sake of 20,000 are in the same class; just another case of tail trying to wag the dog.

My advice to 'em if they don't like your sheet is:—Let 'em quit getting it and start their own and see where they get off!

I enjoy your publication. Even though I'm a writer of short stories and other material far removed from the fields covered by you. I like to sit down in a quiet corner of the club and go carefully through the sheet. I read SCIENCE & INVENTION for two things: amusement and education. Learned must the reader be indeed who can't cull from your pages worth-while and interesting facts that are apt to be of use to him later on.

I didn't mean to be quite so lengthy, but inasmuch as I believe every knock should be counteracted by a boost when it can be given in all honesty, I'm taking a few minutes "off" this morning to tell you that as far as all of us over here are concerned, you're on the right track.

More power to you!

TREVE COLLINS, JR.,
Past Secty. Brooklyn Press Club
6 St. Francis Place,
Brooklyn, N. Y.

THE FAIR SEX WRITES

Editor SCIENCE & INVENTION:

Being greatly interested in the inventive progress of the world, I read quite a number of scientific magazines, but there is none that seems to me as up-to-date as yours. Unlike one or two that I could name, it is not continually giving a rehash of articles published in previous numbers, as though for the mere purpose of filling space. It gives not only the latest achievements of science, but its latest dreams as well, and its pages are filled with fascinating articles making one realize that after all *science* is but another name for *romance*.

At the risk of taking up too much of your time, I wish to comment on a few articles you have recently published.

In April you discussed a subject that has held the deepest interest for me from childhood days—flying through space. I always had faith that science would yet find means for overcoming the obstacles to interplanetary travel, and I rejoice to find there are a few who are qualified to judge of such things who consider the plan feasible. I was particularly imprest by your belief in the possibility of overcoming gravity by means of electrical reaction. A certain scientist says it would be impossible to visit one of the larger planets because its immense gravitational force would crush us; but if your theory of electricity is correct, it would be no more difficult—given the proper equipment—to go about on Jupiter or Saturn than on Mars or Venus.

I hope it will be but a few years at the most ere your dreams of interplanetary travel are realized, for I am impatient to take part in an expedition of this character!

Another article of startling interest is the one in the July number describing the aerohydrotor. I have seen no mention of this device elsewhere.

My best wish for SCIENCE & INVENTION is that it may continue to maintain its present high standard.

MARIE SNOW.

604 Jackson St.,
Tampa, Fla.

A LARGE ORDER

Editor SCIENCE & INVENTION:

I have read the ELECTRICAL EXPERIMENTER since the time when it cost only 5 cents a copy, and it seems to me I liked it better in those days than I do now. Of course, there is still nothing quite so good and maybe you please many more people now than in the old days, but why don't you ever tell us how to make common electrical apparatus anymore? Who wants to make a violin anyway? Why can you not "dope" out some way to make something on the line of the Alexanderson high frequency generator. Can such a machine not be made by an amateur? Now if it

(Continued on page 450)

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Home Electrics

By G. L. HOADLEY, M. E.

IN these modern times, the house-wife uses electricity wherever possible to lessen her work. The installation of several three- or four-way switches, properly located, will save her many steps and will go a long way toward helping her solve the vexing servant problem. For instance, two 3-way switches—one at the top landing, and one at the bottom of the stairway, will make it possible for her to turn on the stairway and hall lights from either floor; the vestibule light should be controlled from both the vestibule and the inside of the house to prevent the annoying and vexatious delay of finding the keyhole in the dark. The garage lights should be controlled from the house and the garage. A handy bed-room should have a switch by the door and one by the bed, so that lights can be flashed on or off quickly without going across the room to do it. Purely as a convenience, the use of 3-way and 4-way switches is more than desirable, and, if we add to that the economy of light effected by their use, their advantages fully warrant their use. It is the purpose of this article to acquaint the reader with these types of switches and explain how to install them properly, as well as show how to use them.

Classification of Switches.

There are three main classes of switches in general use. The knife switch; the push button switch; and the rotary or tumbler snap switch. Knife switches are the least desirable for lighting, especially in exposed positions where children or other inexperienced persons must use them. Rotary or tumbler snap switches are quite generally used for controlling lights, but push button switches are preferable for concealed wiring; altho a little more expensive. A single-pole switch is one which opens one side of a circuit. A double-pole switch opens both sides of a circuit at the same time. Fig. 1 shows these classes of switches properly connected to a circuit. In addition to these, there are special switches known as three-way switches, and four-way switches, which do not differ in external appearance and size from the standard switches above stated.

Three-Way and Four-Way Switches

These special switches are used extensively to control lights from two or more locations. Three-way switches differ from regular switches in that two of the four terminals are strapt together, making three points—hence the term three-way or three-point switch. For example, Fig. 2 shows two points, 1 and 2, strapt together to make one terminal. The strapt terminal thus formed should always be connected either to the source of supply or to the load.

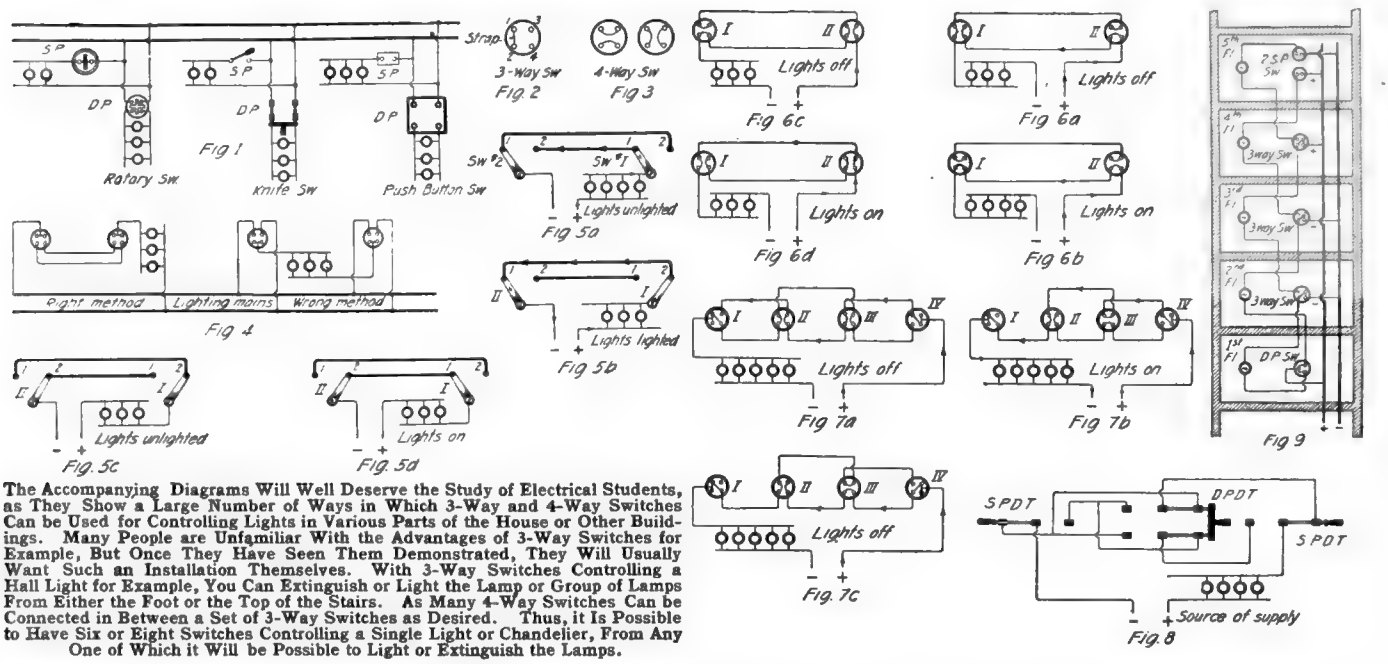
Four-way switches connect together the two top points and also connect the two bottom points of the switch simultaneously with one turn or push of the switch. In Fig. 3, for example, the top and bottom terminals are connected by the switch blades and the next movement would connect the two sides. The four-way switch has two blades while the three-way switch has but one blade, which always is in contact with one or the other of two of the terminals.

Three-way switches are commonly used for stairways or basements where two points of control are desired. Any number of control points may be obtained by the use of four-way switches. Three-way switches cannot be used anywhere except for the end positions, while four-way switches can be used either for the end positions or for intermediate positions.

In general, there are two methods of connecting three-way switches in circuit. Fig. 4 illustrates them. One method is correct, the other is unsafe and should not be used, *as it brings wires of opposite polarity into the same switch.* The Underwriters classify the three-way switch as a single-pole switch, and as such it can properly be connected into but one side of a circuit. A simplified wiring diagram of the three-way switch is shown in Fig. 5*a*, Here the switches are both in the OFF position and the lamps unlighted. Now, move switch I from Contact 1 over to contact 2 as shown in Fig. 5*b*. The circuit is completed and the lamps light. It is obvious that switch I could be moved back up to contact 1, to break the circuit. Let us see if the lights can be shut off at the other switch. Suppose we move switch 2 from contact 1 up to contact 2 as shown in Fig. 5*c*; the circuit is then broken at terminal 1 of switch II. We can, of course, again light the lamps by moving switch 2 back to contact 1 or we can light them at the other end by moving switch I up to contact 1, as shown in Fig. 5*d*. The above simple outline of the operation of the three-way switch will suggest to the mind of the reader how to make up for himself and connect three-way switches. For battery circuits ordinary bell switches, fitted with the proper number of contacts, may be used

Four-way switches may be used for controlling lights from two locations, if desired. Fig. 6*a* shows the switches in the OFF position. Remembering that a four-way switch has two blades, if switch I be turned once, as shown in Fig. 6*b*, the circuit is completed and the lamps light. Switch I can be rotated once more and turn off the lamps also. Suppose, however, it is desired to turn off the lamps at the other end. Rotating switch II once will give it the position shown in Fig. 6*c*. This breaks the circuit as shown and the lamps go out. They can be lighted at the other end again by rotating the switch to position shown in Fig. 6*d*. Four-way switches can be used for controlling the lights from more than two locations, but it is customary to use the cheaper three-way switches for the two ends and four-way switches for the intermediate positions. Fig. 7*a* shows the connections for a combination such that control can be obtained from four different locations. It should be noted here that one of the two wires passing thru all the switches must be cross-connected at each switch. In the position shown, the lights are not lighted. Let us select at random some switch, say switch III, to turn on the lights. One movement of it will complete the circuit and light the lamps as shown in Fig. 7*b*. Now, select another switch at random to turn off the lights—say, switch IV. Fig. 7*c* shows the lights are off,

(*Continued on page* 459)



The Accompanying Diagrams Will Well Deserve the Study of Electrical Students, as They Show a Large Number of Ways in Which 3-Way and 4-Way Switches Can be Used for Controlling Lights in Various Parts of the House or Other Buildings. Many People are Unfamiliar With the Advantages of 3-Way Switches for Example, But Once They Have Seen Them Demonstrated, They Will Usually Want Such an Installation Themselves. With 3-Way Switches Controlling a Hall Light for Example, You Can Extinguish or Light the Lamp or Group of Lamps From Either the Foot or the Top of the Stairs. As Many 4-Way Switches Can be Connected in Between a Set of 3-Way Switches as Desired. Thus, it Is Possible to Have Six or Eight Switches Controlling a Single Light or Chandelier, From Any One of Which it Will be Possible to Light or Extinguish the Lamps.

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The Amateur Magician

By JOSEPH H. KRAUS

The Wonder Fountains

I WAS virtually a stranger as I wended my way to the Long Island home of Professor Hargrave. Everything seemed so different, the grounds had been changed, the building had received its annual wash, and mosquito netting enclosed the porches. There at least is one invention which the famous magician has evidently not worked upon, namely, a method of exterminating mosquitos or making the female of the species less deadly than the male. Letting the knocker on the door fall gently, I was even surprised to see a different maid answer my call. On inquiring whether the Professor was in, I received an affirmative answer, and while the maid went to announce my arrival, I made myself comfortable in the parlor which had been converted into a den.

Here I was not left alone long enough to even acquaint myself with the new objects in the room; one, however, took my particular fancy. This was a fountain composed of a group of mermaids, surrounded by sea horses, holding a bowl which resembled a gigantic lily, from the center of which sparkled the clear waters of a bubbling fountain. Shafts of vari-colored lights illuminated the spray. Suddenly, I heard the familiar call, "Well, well, old topper, I haven't seen you for quite a few months, where have you been keeping yourself?" The earnestness of this exclamation was intensified by a pat on the back, which shook me as tho I had been hit with a sledge hammer. Before I had a chance to reply, he continued. saying, "I am sorry, old chap, I am very busy today, but I have a little stunt here which I know you would like to see. It has something to do with that fountain over there. If you will excuse me while I don my costume for presenting the experiment, I will try and show it to you." With that he left the room.

His departure gave me the opportunity I had been looking for. Ah, thought I to myself, so it is the fountain, well he won't fool me this time. I examined this sculptural masterpiece with the closest scrutiny. There was nothing unusual about it; it was simple a very decorative, self-contained fountain, a motor operating a small pump which forced the water up thru a tiny aperture and vari-colored lights under the basin, which was quite transparent, helped to illuminate the bubbling stream. Satisfied with my examination, I seated myself just a moment before Professor Hargrave entered the room. He was drest in a Turkish costume, a turban covered his practically bald head. In either hand he held a wand.

"Before I show you this performance," he said on entering the room, "I think I will have a drink." Walking to the fountain he stooped over it, and seemingly drank quite a quantity of water, in fact so much, that without any sign of warning a stream of water, about seven or eight feet high, and very thin, wended its way almost to the ceiling, apparently originating at the top of his head. Here it broke and fell down upon him and upon the carpeted floor. He turned around and approached me, the stream never diminishing in height

(*Continued on page 460*)

One of the Most Spectacular Magic Stunts Imaginable is the One Illustrated Above, in Which Professor Hargrave Becomes a Veritable Walking Fountain. The Effect is greatly Enhanced by Colored Lights Which Play Upon Him While the Feathery Streams of Water Shift From the Hand to the Head, Thence to the Foot, and Suddenly All Five Columns Sparkle Forth in the Artificial Light. The Wand Which the Performer Holds in One Hand May be Given to the Spectator. Water Flows From the Wand and at a Given Command it Stops. The Details of the Wand are Shown in the Lower Right Hand Corner of the Picture.

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Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

Some Effects of the Earth's Atmosphere Upon Sunlight

IT is impossible to exaggerate the importance of the atmosphere to all forms of life upon the surface of the earth. If there were no atmosphere there would be no life, because it is thru the agency of the water-vapor, carbon-dioxid and oxygen in the atmosphere that all life-processes are maintained.

If there were no atmosphere there would be not only no life upon the earth but none of the beautiful color effects produced by the passage of sunlight thru the atmosphere. There would be no blue skies, no beautiful sunrise and sunset effects, no twilight, no rainbows, no halos, no auroral displays, and, moreover, no clouds, no rains, no rivers nor seas, no winds nor storms. The heavens would be perfectly black except in the direction of the heavenly bodies which would shine as brilliantly by day as by night.

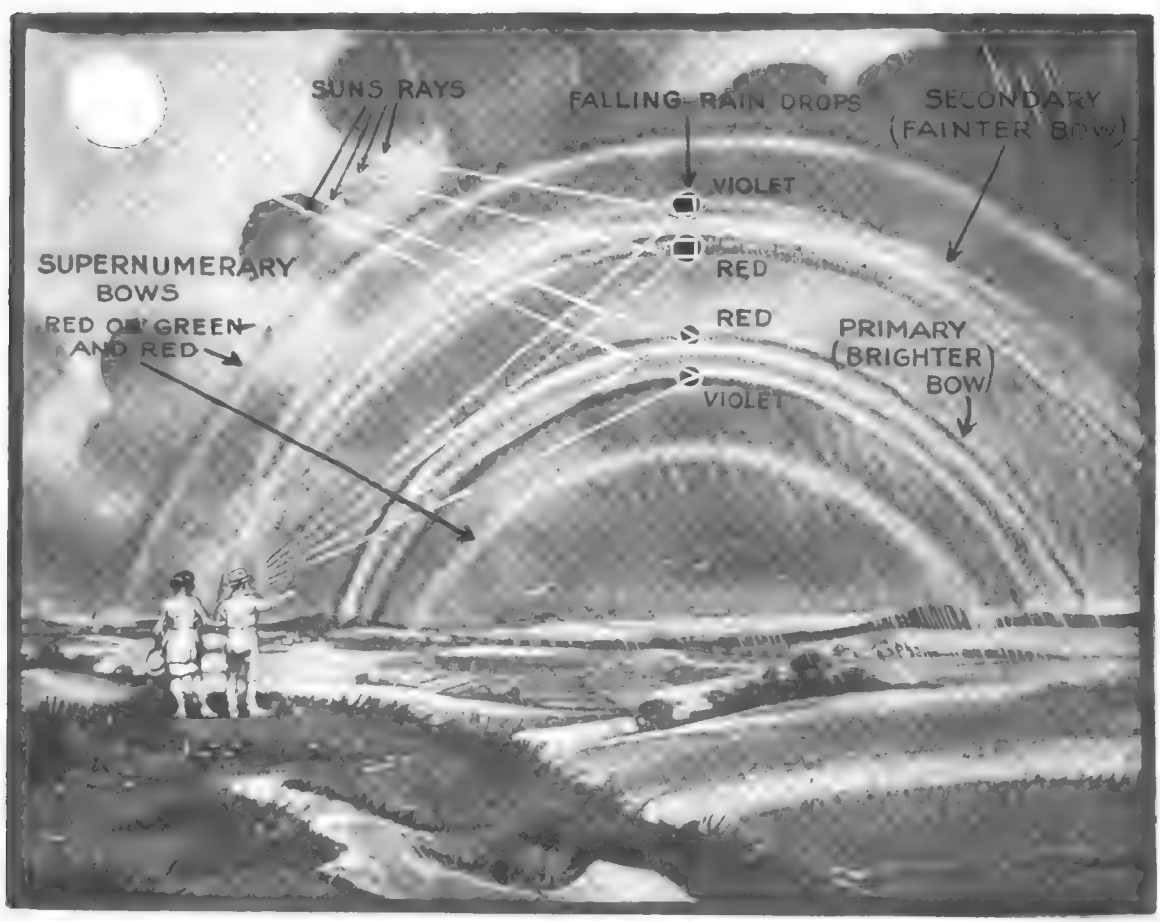
To understand how the atmosphere produces color effects such as blue skies, sunrise and sunset tints, rainbows and halos, as well as the twinkling of the stars, unsteadiness of star images and similar phenomena, we must know something of the nature of light itself.

Light moves outward from any source, such as the sun, in all directions radially, or along straight lines (so long as it does not encounter a gravitational field) with the unimaginable velocity of 186,000 miles per second. As it advances it vibrates or oscillates back and forth across its path in all planes that lie at right angles to this path, unless it is plane polarized light, in which case its vibrations are confined to one plane only.

These vibrations or oscillations of light produce a wave-like motion, one wave-length being the distance past over in the time of one vibration, measured from crest to crest or from trough to trough of adjacent waves.

Now, we may consider a beam or ray of sunlight is made up of a great number of individual rays of different wave-lengths and different colors. The average wave-length of light, the wave-length of the green ray in sunlight, is about one-fifty-thousandth part of an inch, that is it would take about fifty-thousand average wave-lengths to cover a space of one inch. Now, since light makes one vibration in passing over a distance of one wave-length, it makes fifty thousand vibrations, while advancing one inch and since it advances one hundred and eighty-six thousand miles in one second we can easily figure out that a ray of sunlight of average wave-length makes about six hundred trillion vibrations (600,000,000,000,000) in a single second!

The chief colors of which sunlight or white light is composed are red, orange, yellow, green, blue, indigo and violet, tho there are an infinite number of gradations of color which blend into one another, gradually producing the intermediate tints and shades. The colors just mentioned are called the primary colors of the solar spectrum, which can be produced as a band of light of variegated colors, arranged in the order named by passing a ray of ordinary sunlight thru a glass prism. The individual rays of different color and wave-length, existent in a beam of sunlight, or white light, then separate out in the order of the wave-lengths. The red rays vibrate the most slowly and, therefore, have the longest wave-length of all the rays of the visible spectrum. About four hundred trillion vibrations of red light reach the eye in one second. Violet rays, on the other hand, vibrate the most rapidly of all the visible rays with shortest wave-length. About eight hundred trillion vibrations of violet light reach the eye every second The wave-lengths of the intermediate colors decrease in length progressively from the red to the violet and, of course the frequencies of their vibrations increase in the same order. All sunlight is made up of these rays of different colors and different-vibration frequencies, and of other rays as well, to which the human eye is not sensitive, and which, therefore, do not appear in the visible spectrum. Among these invisible rays are the infra-red rays, which come just below the red of the visible spectrum, and which are of longer wave-length than the red rays, and the ultra-violet rays which lie beyond the violet rays of the visible spectrum and are of shorter wave-length than the violet rays.



Even if Standing Close Together Two Observers Will Each See a Different Rain-Bow Altogether. This Illustration Shows How the Light Rays are Affected in the Falling Rain-Drops. The Path of the Light Taken in the Primary Bow Is Totally Different From the Path Taken in the Drops That Will Form the Secondary or Fainter Bow. In the Primary Bow, Violet Occupies Always the Inside and Red the Outside.

Now a ray of ordinary sunlight is separated into the rays of various colors, which form the solar spectrum when it passes from a medium of one density obliquely to a medium of another density, as when it passes from air to glass or from air to water or from outer space into the earth's atmosphere. Under such circumstances its velocity is changed, slowed down when it passes from a rare to a denser medium, and the waves of different wave-lengths are bent from their former course, or refracted, by different amounts. The red rays of longest wave-length are bent from their former course the least and the violet rays of shortest wave-length are bent the most upon passing from a rare to a denser medium. As a result the ray of sunlight is spread out or dispersed into its rays of different wave-length and color upon entering a medium of different density. It is this refraction and dispersion of sunlight that produces many color effects in the earth's atmosphere.

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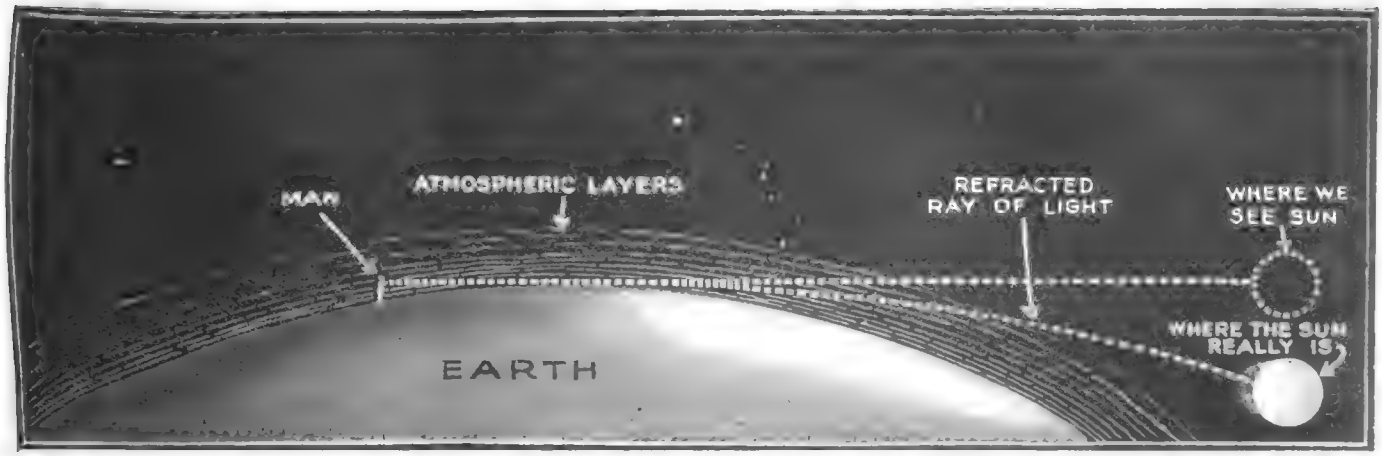


The Above Illustration Shows a Phenomenon Which Is Not Known to Many People. When We Gaze at a Beautiful Sunset We Do Not See the Sun at All, But Only a Picture of the Sun. The Above Illustration Explains This. Due to the Atmospheric Layers, the Sunlight Is Deflected in Such a Way That at Sunset, the Sun Has Long Descended Behind the Horizon.

The atmosphere, as we know, is not of uniform density thruout. At high altitudes it is extremely rare. That is, there is little of it in a given volume. Close to the earth's surface, however, it is comparatively dense. Half of all the atmosphere is within three and one-half miles of the surface and half of the remainder lies within the next three and a half miles. We may consider it as made up, on the whole, of layers of different densities, strongly comprest near the surface.

Imagine a ray of sunlight entering the earth's atmosphere from without. If it comes from a point in the zenith its course is not changed upon entering the atmosphere, because light passing from a certain medium—as space—into a medium of different density, is not bent from its course, or refracted, provided it enters the new medium in a direction perpendicular to the surface. If it enters the atmosphere (which is the new medium of greater density) *obliquely*, refraction, or bending of the ray, takes place, and as the ray advances toward the earth, thru layers of increasing densities, it is bent from its former course more and more. As the advancing rays of different colors and wave-lengths in the beam of sunlight are slowed down in the new medium, the red rays are turned from their course the least and the violet rays the most and the entire advancing wave-front of the beam of sunlight is bent down more and more toward the horizon, as it proceeds thru the atmosphere. As we on the earth's surface see the ray not along its bent course thru the atmosphere, but in the direction in which it finally enters our eyes, the effect of refraction upon a ray of light passing thru the atmosphere, is to displace the object in the direction of the zenith or raise it above the horizon. As a result of refraction *we see the sun, or moon, above the western horizon*, after one or the other has really set, and above the eastern horizon before either one has really risen. The oval shape that the sun, or moon, often shows on rising or setting, is due to the fact that the light from the lower limb is passing thru denser air than the light from the upper limb, and so is refracted more and as a result the lower limb is lifted proportionally more than the upper limb. This distorts the form of the solar or lunar disk, making it appear oval instead of circular.

The familiar twinking or scintillation of stars and, more rarely, of the planets, is a result of interference of light waves due to irregular and variable refraction in air, that is not uniform in density, owing to the presence of constantly rising and descending atmospheric currents of different densities. This also produces the shimmering or unsteadiness of star images in the telescope, that interferes so greatly with accurate measurements of angles or observations of planetary markings, and rouses the ire of the astronomer, driving him to the mountain tops or high plateaus, where the air is comparatively clear and steady.

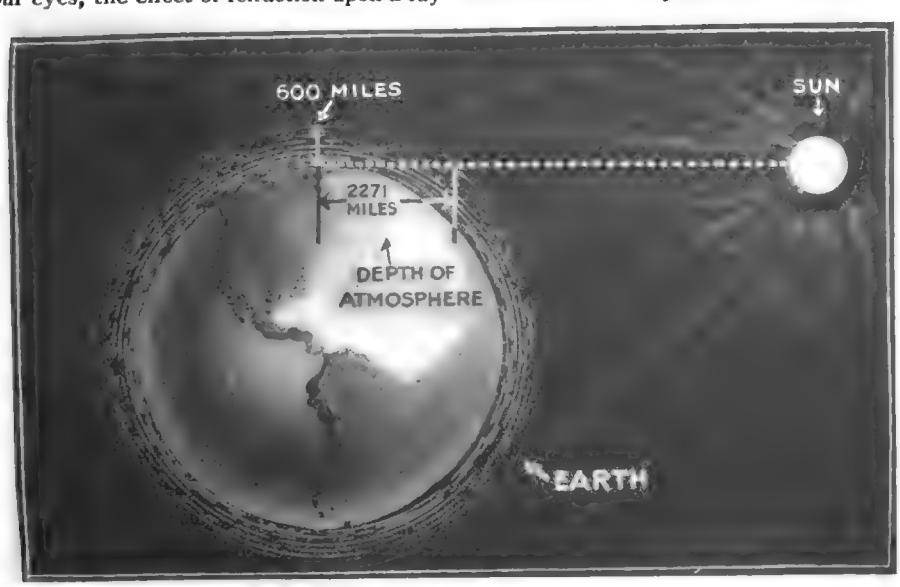
One may ask, why it is, if light from an object, say a star, is bent from its course and separated into rays of various colors upon entering the earth's atmosphere, that we do not see the object drawn out into a band of spectral colors. This is due to the fact that the angular dispersion is so slight under ordinary circumstances that light from one point is blended with light from a neighboring point of complimentary color to produce white light again. There are, however, certain circumstances that result in beautiful color effects in the earth's atmosphere due to the refraction of sunlight.

If, under favorable conditions, one observes the upper limb of the sun sinking below the horizon it may be possible to detect the "green flash," which is an effect of refraction. Sunlight at this time is strongly refracted, and the dispersion is then greatest, as the path of the ray is along the horizon and thru the densest part of the atmosphere. The red rays, being bent least from their course, pass below the horizon first, then the yellow and next the green, the blue and violet coming last. Just as the red and yellow rays from the upper limb have disappeared below the horizon it should be possible to see an instantaneous green flash from the green ray since the light from its complementary color red which ordinarily blends with it to produce white light is then below the horizon. Theoretically we should also see the blue and violet rays immediately after but, as we will soon see, very few of these rays of shorter wave-length can penetrate thru the dense lower strata of the atmosphere. This same "green flash" is also observable at sunrise just as the upper limb is coming into view, the colors then appearing in reverse order.

The blue color of the sky and its brightness is caused by the scattering of the rays of shortest wave-length, the violet and blue rays, by the oxygen and nitrogen in the upper atmosphere. The molecules of these gases interfere with the passage of these rays, powerfully scattering and dispersing them, and thus increasing the length of their path thru the air and diffusing their color and brightness in the upper atmosphere, while permitting rays of longer wave-length the red and orange to pass thru practically undisturbed.

When an object in the heavens is viewed near the horizon, the rays of light from it have to travel a longer path thru the atmosphere than when it is overhead, and that too thru the densest part of the atmosphere, which lies close to the earth's surface, and in which are floating many dust particles and impurities from the earth's surface. All these particles, as well as the increased density of the atmosphere, interfere with the free passage of the rays, especially of shorter-wave lengths, thru the atmosphere. The violet and red rays are sifted-out and scattered in their long journey thru the lower strata of air, far more than if they came from an object high in the sky. Even the red and yellow rays are more or less scattered and bent aside—diffracted—by these

(Continued on page 479)



The Above Illustration Explains Why We See the Sun a Brilliant White at Noon, Looking Overhead, While It Becomes Reddish Yellow at Sunset. The Reason Is That at Noon We Are Viewing the Sun Through a Layer of Air 600 Miles Deep, Whereas at Sunset We Have to View the Same Sun Through a Layer of Air Which Is Over 2200 Miles Thick, or More Than 3 Times as Thick as at Noon.

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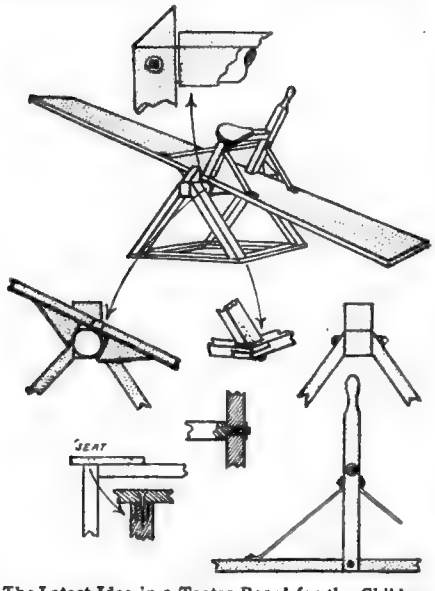
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

TEETER-BOARD

A teeter-board that can be used on the lawn and moved about so as not to kill the grass is shown in our illustration. This board has a new innovation in which the teeterer is provided with a seat and lever to operate it, in fact with this arrangement



The Latest Idea in a Teeter-Board for the Children. This Teeter-Board Possesses a Distinct Novelty in That the "Master of Ceremonies", Instead of Having to Stand at the Center of the Board and Rock it To and Fro, Can Here Sit Down and Hold on to the Upright Handle.

it is doubtful if the despised function of teetering others does not become the most desirable job on the teeter-board. The board is strongly constructed and if carefully made and painted will make a very attractive toy for the lawn—the board might be lemon-yellow, and the other parts grass-green. The drawings give the method of construction, the teeter, say eight feet long, with the teeter-horse thirteen inches high and the seat 12 inches above the plank.

LAWN SWING

In the illustration is shown a design for a swing, which swing has the advantage of being portable, if small, and of being decorative, if constructed as a large permanent fixture; painted grass green, the swing will be an ornament to any lawn. It is strongly constructed and safe, being put together largely with screw bolts. The drawings show the construction-plan and illustrate the proper proportions of the various parts. Whether the swing is made large or small these proportions should be kept for the sake of symmetry. The boy-scout of the family can exercise his knowledge of ropeology in splicing the swing rope where its two ends are attached to the rings at the top.

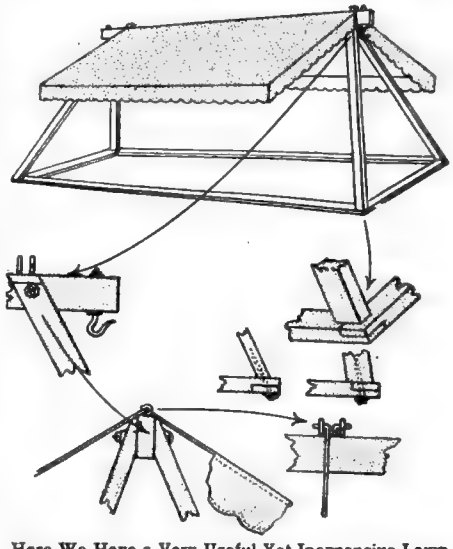
The wooden frame for this lawn swing may be constructed of any odds and ends of lumber which may be at hand; 2″ x 4″ stock could be employed but the swing will be much improved, especially if it is to be used by adults as well as children, if the two uprights at least are constructed from 3″ x 4″ or better still, 4″ x 4″ material. If the wood stock is purchased in the rough it can be smoothed up with a little care by means of a carpenter's jack-plane and sand paper, if desired. It can be painted any color that the owner may elect, green being a good one, but some people prefer white or the popular brick red. If the latter color is used with plenty of good red lead in it, it will prove a very fine preserving coat against all kinds of weather.

HAMMOCK SWING AND AWNING

A portable hammock swing and awning is shown above at right. There is a frame, which will sit safely on the lawn, without injuring the sod or killing the grass; it is simple in construction, but as firm and solid as a rock, being held together with screw-bolts in such fashion that the least strain on the hammock-hooks locks all of the parts together. The awning is composed of two U-shaped iron frames hinged to the ridge pole of the hammock frame in such a manner that one-half of the awning on either side of the hammock can be raised by lifting with the hand. They work in this respect like any awning frame—which they in many ways resemble, the canvas being put on and attached to them in awning fashion—the difference being that they are lifted or lowered without ropes. Ropes can hold them down however, in case of strong wind just as an awning is secured. The canvas for the two sides is in one piece or joined with a reinforced ridge piece at the top, this insures protection from the sun, when at its height, and enables the two awnings to be instantly removed, when the iron parts are unhinged as in case of a wind storm.

LAWN MOWER SHELTER

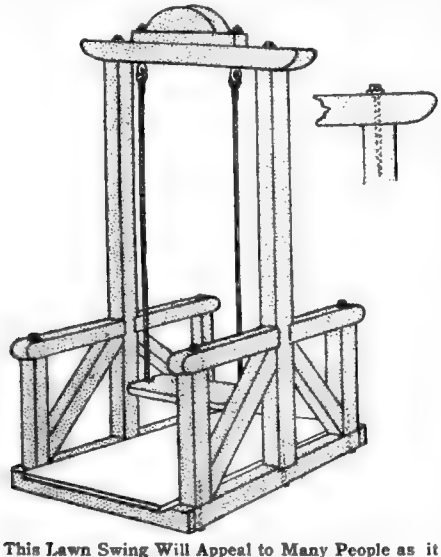
A water and damp proof shelter for the lawn mower, clippers and sickle, that sits right out on the lawn, and is surrounded by appropriate foliage, seems to be a desirable acquisition. We show in our illustration a tower in miniature, designed to meet this long felt want. The tower is about eight feet high (not counting the weather vane) and about three feet square at the largest



Here We Have a Very Useful Yet Inexpensive Lawn Hammock Support, Provided With an Awning. The Wooden Frame Is so Designed That it Can be Built Quite Light and Yet Possess Great Strength, and, Moreover, it Will Not Injure the Grass.

point—yet size is a matter largely regulated by judgment on the part of the home mechanic.

The chief concern is to keep the tools from rusting in damp or rainy weather and the shetler is designed so as to form a protecting receptacle at such times. It should sit on a concrete foundation extending an inch or two beyond the base of the tower and runway, and level with the top surface of the sod. The wood floor—raised about eight inches above the concrete, provides a kind of cellar in which air can circulate freely at the bottom of the tower, the ventilation at the top keeps the tools from sweating or condensing moisture. The outside and bottom of the completed tower should be coated with crude creosote before painting; when the creosote is dry, paint the roofs a light red and the other work stone gray—all but the roofs and top of runway can be sanded.



This Lawn Swing Will Appeal to Many People as it Is Not Only Very Substantial, but also Quite Artistic, and if Painted Green or Some Other Desirable Color, it Will Present a Very Neat Appearance.

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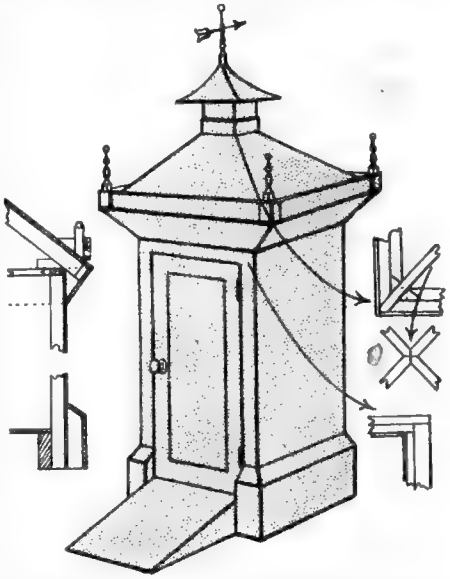

Above We Show a Very Attractive Water and Damp Proof Shelter for the Lawn Mower, Clippers and Sickle. This Can Be Made Very Attractive.

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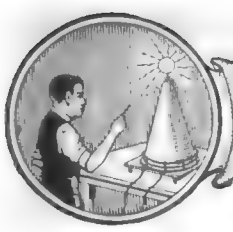
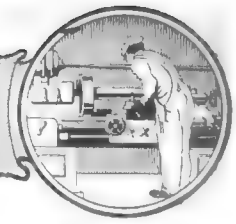


THE CONSTRUCTOR



The Magic Crystal Gazing Globe

By PRESTON LANGLEY HICKEY

FOR centuries and centuries, as far back as man's history has been recorded, the crystal gazing globe has been one of the principal means by which so-called philosophers and mediums have profest to be able to foretell the past, present and future events in the life of a believer in the occult. With passing years the popularity of this enigma has increased to such an extent, that many of our scientific writers are devoting their time to studying and expounding the theories of spiritualism and life after death before the world.

During the past ten years I have been an ardent devotee to magic and spiritualism as a hobby, and to back up and prove my statements in the above paragraph, I will explain in detail here, a method of the crystal gazing globe, of my own invention, very simple, the like of which exists no where else, and yet with which I have mystified even those who flattered themselves on being quite proficient in the art.

The effect of my séance was as follows:

Close up against the wall, usually in front of a heavy drape as a fitting background, with just enough room behind it to place a chair for myself, stood a little table, on which was my *crystal*. My spectators were seated in the form of a half circle between ten and fifteen feet from the crystal. When everything was ready for the performance, the lights were turned out. The spectators were then requested to ask questions, being cautioned all the time to keep their minds concentrated on what they wished to know, and their eyes fixt upon the crystal, which they could see only very faintly in the gloom. Suddenly the crystal seemed to radiate with a faint glow of light, varying from red, blue and green to white. This light gradually grew brighter, but that was not all. At the same time, from within the very depths of the crystal, a seething mass of vapor mysteriously swirled about. Each varying colored vapor had its own significance, which of course I would explain, and then at the conclusion, I would switch on the lights, and nothing but the cold crystal remained, all other colored lights and vapor having vanished. The effect was very startling and beautiful to say the least, and never once was I detected in my performance.

While the illusion in itself is a rather complicated affair, a careful perusal of the directions set forth here and the accompanying diagram will give the reader a clear mental picture of the details of construction.

Secure four pieces of timber two by two inches square and thirty inches long. These will act as legs for your table. For the top, which should be sixteen inches wide by fourteen inches long, any piece of small board of that dimension and not over three quarters of an inch in thickness will do, altho, from a personal standpoint, I think a piece of compo board is the most advisable, as it is very light, and yet very strong and durable. Any sort of thin strips of wood may be employed as reinforcements to the legs and top of the table. A fringed and decorated drape, is tacked around the edge of the table top, and hangs down to within not more than a foot from the floor. Thus all apparatus and working mechanism is securely concealed, and even the unusual length of the drape never excites suspicion.

To do away with any confusion whatsoever, in the *modus-operandi* of the crystal, I will refer you rather closely to the illustration.

The crystal is in reality merely a large clear lamp globe set firmly in the pedestal. To buy a real crystal fifteen or twenty inches in diameter, would cost you well over a hundred dollars, and then again, in this particular effect it could not be employed, owing to the appearing vapor. In the pedestal, are four little sockets in which fit the four colored lights that are employed.

(*Continued on page* 456)

Complicated as the Magic Effect of the "Crystal Gazer" May Seem, it Is Much Simpler Than One Might at First Suppose. The Elementary Chemical and Mechanical Devices Employed in Causing the Large Glass Ball to Fill With Vapor or Smoke, are Clearly Described by the Author, so that Anyone Interested in the Device Can Readily Build it. Not Only Does the Glass Ball Become Filled With Mysterious Looking Vapors at the Command of the Demonstrator, But the Color of the Vapors Can be Changed Thru a Wide Range, by the Clever Utilization of Several Colored Electric Light Bulbs. These Bulbs are Connected With Dimmers or Rheostats So That a Very Wonderful and Mysterious Blending of Colors Can be Produced at Will.

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Building Home-Made Transformers

By H. H. PARKER

SMALL transformers suitable for operation on any 110 volt house lighting circuit are of fairly simple construction for the amateur and with a little care will always prove successful in use. This article describes a few details of small transformer construction which will interest those who contemplate building one.

After the sheet iron core material has been obtained, and it will always be to the builder's advantage to purchase the sheets ready cut to shape, they must be piled up, comprest and bound into a rigid core, but open at one end for the insertion of the windings. This is a tedious operation and unless care is taken, the laminations will become mixed up and out of alignment. A convenient method is to construct a wooden form and build up the core around it; the little time taken to make the form will be more than compensated for by the speed at which the sheets may be piled up into shape. The base board is made the exact size of the outside of the core, the inner block being considerably higher than the core is to be, to allow for the springing apart of the sheets, and of the size of the core-opening. Several wood or sheet iron clips screwed to the base board, but capable of being turned down out of the way, serve to hold the sheets in line, but can spring out to admit any sheets wider than the rest. The front edge of the base board is separate, as far as the line of the inner block, and held by screws; then when the sheets are piled up and held temporarily by a pair of clamps on each side, this block is removed, thus exposing the whole of the lower core yoke. This yoke is held in a vise and the side clamps and wood form may then be removed, and all is ready for the next operation—that of binding the core-leg laminations tightly together. One way to do this is to wrap on ordinary black friction tape, always keeping a clamp around the core just above the wrapping. This friction tape has rather poor insulating qualities and is used only for its mechanical strength, so to do away with its use and produce at the same time a stronger and neater binding, a number of sheets of heavy tough brown paper are cut out the length of the core winding space, and wide enough to reach a little more than half way around the core. Two hardwood or metal blocks are procured, also the length of the winding space; the corners of the core are slightly rounded with a file to prevent cutting the paper; from four to eight of the paper sheets are then placed between each side of a core leg and the clamp block, and the whole then clamped very tightly together.

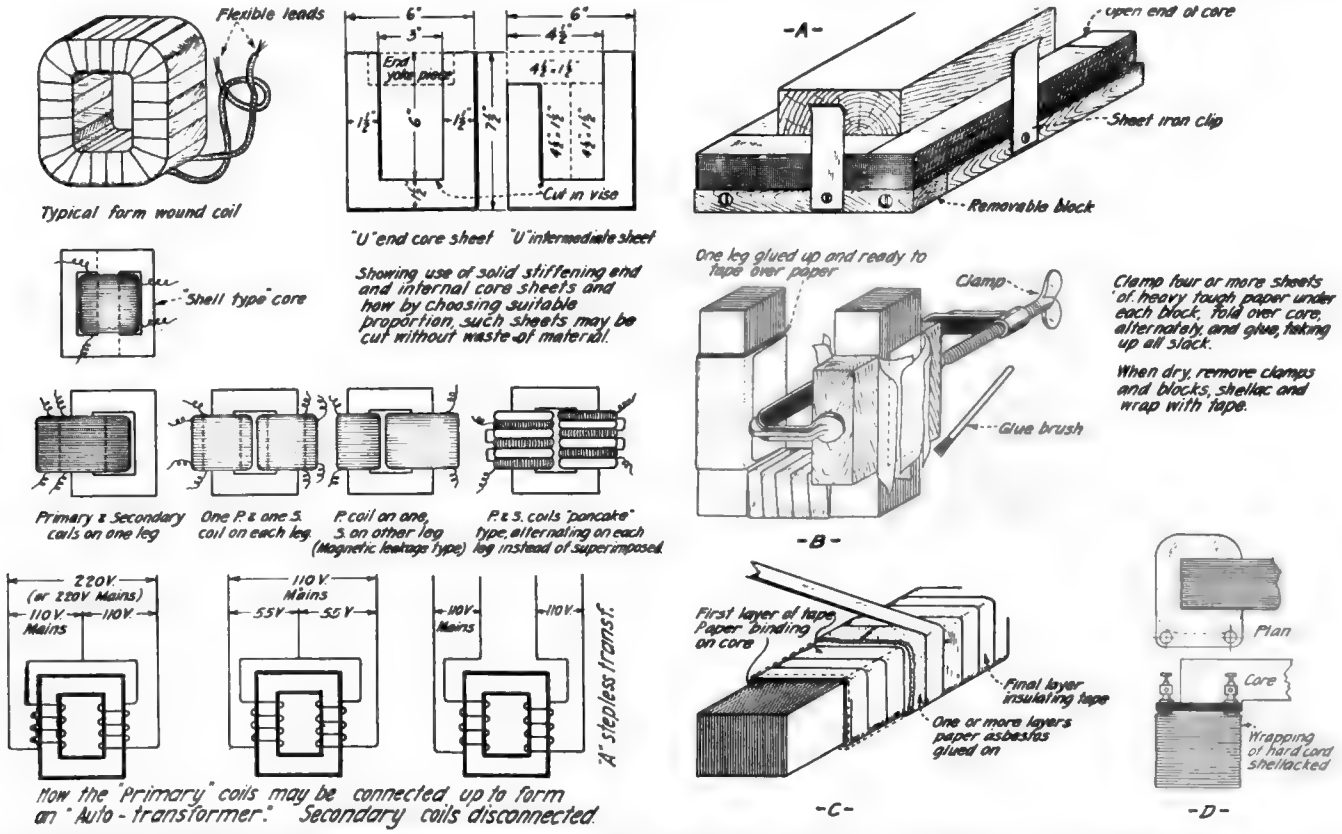
This leaves the edges of the paper sheets sticking out on each side and they are then to be folded over the inside and outside of the core leg, alternately, stretched tight and glued in place. When the glue is dry and the clamps and blocks removed, the paper will bind the core legs tightly together, but to prevent subsequent tearing, a wrapping of either "armature" tape, shellacked, or the more expensive varnished insulating tape is put on and the ends glued or securely bound.

If the transformer is to be used for welding or other purposes where a heavy current will be drawn and there is liability of the windings heating up, it is of advantage to put on a further covering of two or more sheets of asbestos paper, glued to the tape wrapping, then to put another layer of tape on over the layer of asbestos.

While on the subject of core construction, it would be well to mention, that, if there should be any large sheets of the core material at hand, which is not in the form of narrow strips, a good plan is to cut out two or three "U" shaped end-pieces for each side of the core, as well as two or more to be placed in the middle. Such solid pieces strengthen the core and help to hold it in alignment, as well as to improve the magnetic circuit. Often these may be cut with no waste of material, by giving the core certain proportions, such as shown in one of the sketches. In this way the center of the sheet will make two extra leg pieces, or, in the case of an internal "U" sheet, three of the shorter yoke pieces. The lower cut is easily made by clamping the sheet in a vise having straight smooth jaw edges, then cutting close to the jaw with hammer and sharp cold chisel. In assembling the pieces to fill in the open end of the core, one of the yoke pieces is placed across each end-sheet, overlapping part way, and the whole yoke is then bound with friction tape.

Little will be said here upon the subject of coil winding. Probably the best scheme for the winding is to use the form wound taped coil, with flexible leads. Such a coil can be strongly constructed, entirely separate from the core, well insulated, neatly taped, shellacked or varnished, baked and when dry, slipt into place over the core. There are several ways to group the primary and secondary coils; in a small transformer, up to 100 watts or so, both may be wound on one leg of the core. Larger ones are more compact and efficient if half of each winding is placed upon each leg, usually with the coarse wire coils placed next to the core. Sometimes it is preferable to place the primary on one leg and the secondary upon the other; this is known as a "magnetic leak-

(*Continued on page* 462)


Flexible leads
Typical form wound coil
6"
3"
6"
4½"
End yoke piece
4½-1½"
1½"
7½"
Cut in vise
"U" end core sheet
"U" intermediate sheet
Showing use of solid stiffening end and internal core sheets and how by choosing suitable proportion, such sheets may be cut without waste of material.
"Shell type" core
Primary & Secondary coils on one leg
One P. & one S. coil on each leg
P. coil on one, S. on other leg (Magnetic leakage type)
P. & S. coils "pancake" type, alternating on each leg instead of superimposed
220V (or 220V Mains)
110V Mains
110V
110V Mains
55V
55V
110V Mains
110V
"A" stepless transf.
How the "Primary" coils may be connected up to form an "Auto-transformer." Secondary coils disconnected.
-A-
open end of core
Sheet iron clip
Removable block
One leg glued up and ready to tape over paper
Clamp
Glue brush
Clamp four or more sheets of heavy tough paper under each block, fold over core, alternately, and glue, taking up all slack.
When dry, remove clamps and blocks, shellac and wrap with tape.
-B-
First layer of tape. Paper binding on core
Final layer insulating tape
One or more layers paper asbestos glued on
-C-
Plan
Core
Wrapping of hard card shellacked
-D-

Many Valuable Ideas are Illustrated and Described Herewith in the Building of Home-Made Transformers. The Diagrams at the Left Show Various Ways of Arranging the Primary and Secondary Coils, as Well as Methods of Connecting These Coils to Circuits of Different Voltages. Referring to the Diagrams at the Right of the Illustration, "A" Shows the Wooden Form Used in Building Up the Sheet Iron Core. At "B" Is Shown How the Core Laminations are Held Closely Together by Gluing Paper Around the Legs of the Core. "C" Shows the Core Leg Wrapt With Asbestos as Well as With Tape, While "D" Shows Fiber Coil Head Construction, With Binding Posts Mounted Thereon.

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Construction of a Gasoline Blow-Pipe

By FRED W. DIXON

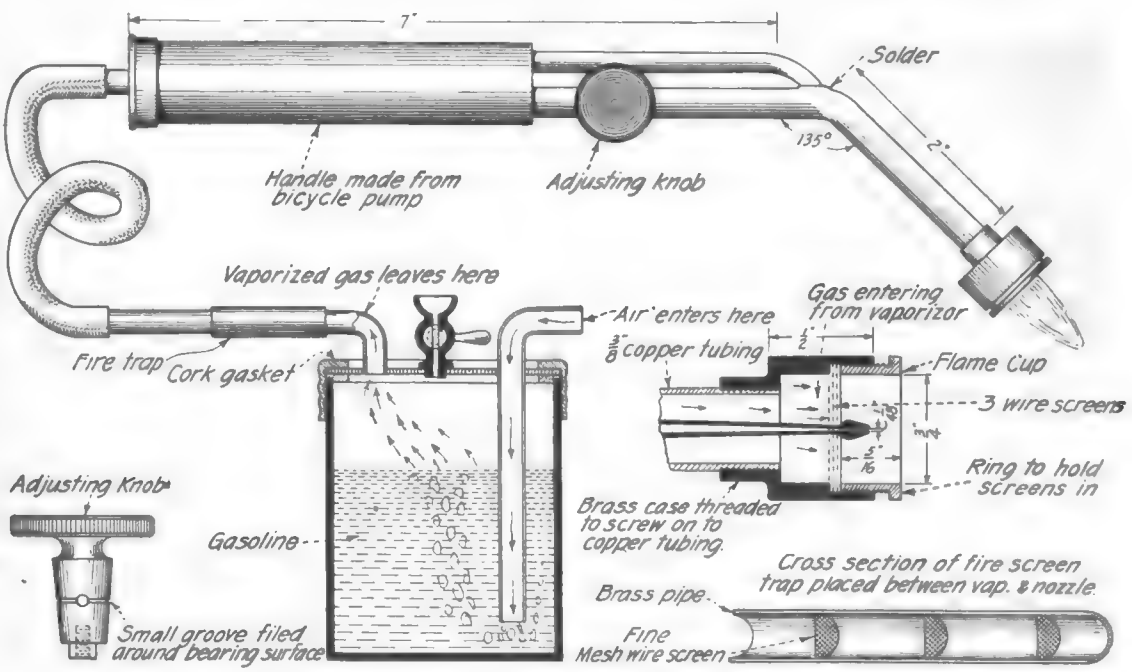
HOW often have you wished for a fine pointed, hot flame that could be operated in any direction? Doubtless many times. You had the soldering iron ready but it was too clumsy to get at the work, or lost its heat too rapidly. The blast lamp gave too large a flame, while the alcohol lamp wouldn't reach the spot, and there you were "stuck," or else you had to make a job that did not suit you.

The blow-pipe described here is a very efficient type. It gives a fine, hot, pointed flame, that may be made large or small as desired, and may be operated in any direction. Its construction is quite within the capabilities of any amateur experimenter, and the old, reliable "junk box" is sure to have something to contribute to its manufacture.

This blow-pipe will be found excellent for ordinary soldering, soldering pipes in automobile radiators, building up lead terminals on storage cells, melting sealing compound around battery jars, light brazing, and other innumerable uses.

The essential parts are a source of comprest air, the carburetor or vaporizer, and the nozzle.

The Gasoline Blow-Pipe Here Illustrated is of Very Efficient Type and Gives a Fine, Hot, Pointed Flame That May be Made Large or Small as Desired. Furthermore, the Flame May be Thrown in Any Direction. The Constructional Details of This Blow-Pipe Are Quite Within the Capabilities of Any Amateur Experimenter, and It Will be Found Very Excellent, Indeed, for Ordinary Soldering, Repairing Automobile Radiators, Building Up Lead Terminals on Storage Cells, Melting Sealing Compound on Battery Jars, Light Brazing, and Many Other Uses.



The air supply may be the same as is used for inflating tires, that is a comprest air tank, or a small tank may be obtained to hold a moderate pressure. The pressure required is not great, as five pounds pressure in a tank will run it satisfactorily; of course the tank used should hold more than this pressure, else the tank will soon be empty of air.

The carburetor is constructed according to the diagram. The case consists of an ordinary pint jar with straight walls as shown. A plate, preferably of brass, is cut to fit on the top and thru this three holes are drilled. In one hole a tube is soldered, which runs to the bottom of the jar. This tube should have an internal diameter of about one-eighth inch. On the other hole, diagonally opposite, is soldered an elbow, and on the center hole, a priming cock. Underneath the brass plate is placed a cork gasket which is shellacked, so that, when the rim is screwed down, it will seal the brass plate on the jar, thus preventing air from leaking out. The pipe, going to the bottom of the jar, is connected to the air supply, the elbow connects to the nozzle, and the priming cock is used to pour the gasoline into the vaporizer. The gasoline should have its level about two-thirds of the way up in the jar. This constitutes the *vaporizer*.

The nozzle presents more difficulties than the carburetor, but by carefully following the drawing its design is easily understood. The handle is made by using a bicycle pump, of the type having a short metal cylinder, and only the cylinder and end cap are used. The end cap, which screws on. has a tube soldered into it and this is connected to the carburetor for the entrance of the gas. Into the other end of the cylinder two pipes are to be soldered.

The bottom pipe is the larger and is made of three-eighths inch tubing. Copper tubing is preferable as it is easier to bend. In bending the tubing, one end should be tightly corked, and then the tubing filled full of tightly packed sand, after which the other end is corked. The tube can now be bent without flattening at the bend. The angle of the bend should be about 135 degrees. The lengths of the tubes are shown in the diagram.

At the end of the handle and connecting with this large tube is a small pet-cock, which is fixt in this manner. The screw is removed and the inner part taken out. Using a small three cornered file, file a small groove no deeper than the thickness of a pin connecting the two holes around the bearing surface, and all the way around. This allows some gas to pass the tap even when it is set closed.

The construction of the flame end is best studied from a diagram. The cup-shaped end has a diameter of three-fourths inch and is constructed of brass on the lathe unless the "junk" box yields something. If it is threaded so that it can be screwed on, it facilitates matters should cleaning be necessary.

Three screens are used in this flame cup, the first being of the type where small holes are punched thru thin metal discs—the other two screens are of fine brass of 50 or 60 mesh or thereabouts. The number of screens is obtained by experimenting, it depending on the smallness of the mesh of the wire. The upper ring shoves in tightly against the case and holds the screens in place.

Between the vaporizer and the nozzle it is generally advisable to place a *fire screen* or *trap* of the design shown. This removes dirt, and eliminates any tendency for fire to go back and ignite the gasoline at the vaporizer.

The top pipe coming from the cylinder is an ordinary *mouth blow-pipe*—it may be obtained from places dealing in scientific supplies. They are used by jewelers and also for performing blow-pipe tests on minerals. An ordinary pipe may be used if a suitable tip can be fitted on. The hole in the end of this should be about 1/48 inch in diameter or the size of an ordinary pin. This small pipe enters the interior of the lower and larger pipe at the angle, and is soldered there. The end with the tip projects thru the interior of the larger pipe into the flame cup, and its end is just above the wire screens.

The advantages of this type of blow-pipe are its ease and simplicity in operation, its cheapness, its ability to operate in any direction, and the fact that there is no waiting as in the ordinary blast lamp—you simply turn on the air and light the gas at the nozzle. The pet-cock on the larger pipe controls the size of the flame which may be varied from a pencil point to one as large as a blast lamp. A grade of gasoline, of fairly high volatility, should be used, or else in the poorer grade, the volatile parts vaporize, leaving the less volatile portion which collects in the vaporizer giving a poor flame. In case low test gas is used this almost non-volatile part should be removed and fresh gasoline substituted. The rubber tubing, obtained at the drug store, for connecting the parts, is best selected with thick walls to prevent kinking.

While this gasoline blow-pipe may be constructed from various odds and ends to be found about the work shop or in the usual *odd-parts* box, it will be much more efficient all around undoubtedly, if the various parts are made as carefully as possible and of good materials. The burner nozzle for example, could very well be constructed by a machinist and the cost would be within reason. Another part that can very well be made of metal instead of glass, is the carburetor or vaporizing chamber. A metal chamber is preferable to a glass one, as there is then no danger whatever of breakage. The valves or pet-cocks can be purchased at most hardware stores or steam fitting and plumbing supply house, also. The rubber tubing required can be purchased at drug stores or chemical supply houses.

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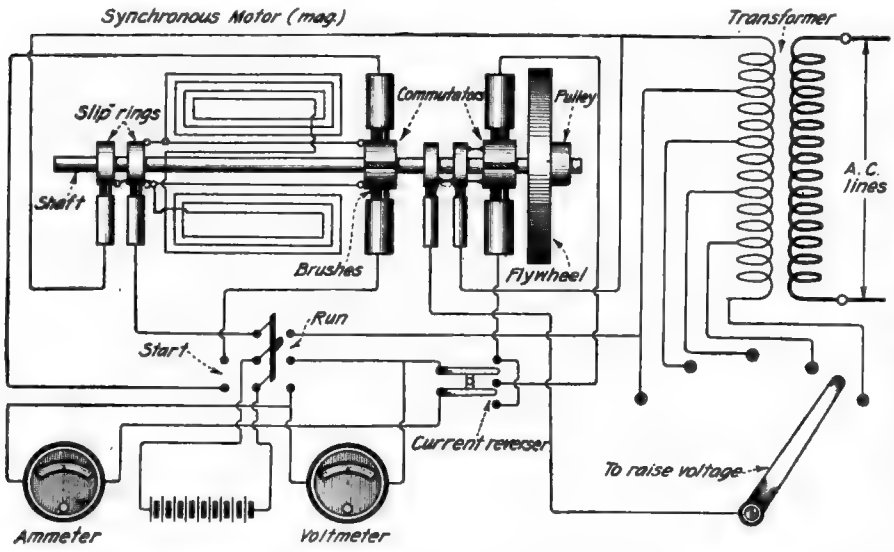
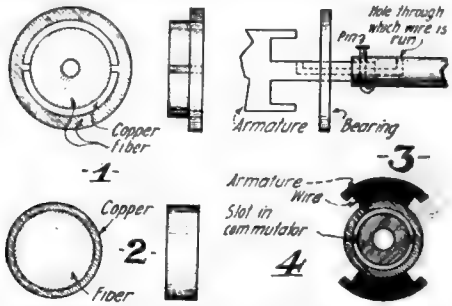
Novel A.C. and D.C. Machine

A.C. or D.C. Generator, Converter, Synchronous Motor or D.C. to A.C. Machine

SOME time ago I constructed a very simple yet efficient rectifier which performed a variety of functions. So low was the cost of constructing this device which was subsequently tested out by myself at the *Dunwoody Industrial Institution* with the resulting determination of an efficiency of 90 per cent that I decided to pass on the information so gained to other experimenters, who are interested in such contrivances. Altho a laminated armature in an ordinary telephone magneto is unquestionably superior to the solid iron core armature, which I used, nevertheless the surprising efficiency developed by this simple machine, in spite of continuous running, will sanction the use of the regulation type telephone magnetos, even tho they are constructed cheaply and with solid iron core armatures. Taking one of these apart I rewound the armature with No. 20 B. and S. gage single cotton covered copper wire. After which I constructed two 2-segment commutators and four slip rings. These presented a little more difficulty than I had anticipated, but nevertheless they were completed in short order. Inasmuch as the size does not have to be definitely given, the experimenter will find it best to make use of materials which he may have on hand, and he undoubtedly will find, among those materials, commutators, which could readily be adapted for use in a machine of this nature.

The shaft will have to be extended, so as to allow these commutators and slip rings to be fitted to it, but this does not present any grave difficulty, because the shaft of a new machine is already drilled to fit a machine screw. If this hole is drilled deeper and tapt and a piece of steel rod, threaded to fit, is screwed into the tapt armature, a perfect fit will be obtained and the shaft will be properly lined up. On several other machines I have found it equally advisable to fasten a shaft between two bearings, and connect directly to the armature with a small universal joint. Numerous other ways will suggest themselves as for instance, a coil spring or a piece of rubber hose firmly attached will answer the purpose of a universal joint. The shaft can also be fitted without the necessity of tapping in a piece of steel rod, by simply drilling a hole in the end of the rod to admit the end of the armature shaft and then a hole at right angles to allow for the insertion of a pin, as shown in Figure 3. Only one auxiliary bearing will be necessary here. The brushes should be so set, that they may be adjusted to decrease sparking, ultimately they may be permanently fixt in this position. Not only can this machine be used to change alternating current to direct current, but also vice versa. When this is done, one can with the aid of a transformer, step up the potential, so that a bulb normally operating on a 110-volt circuit, can be heated sufficiently to give a very brilliant light. When this machine is run by an outside source of power, it will generate direct or alternating current simultaneously. If the experimenter desires a motor with a constant torque, it may be run as a synchronous motor, being supplied by current, taken from a step-down toy transformer. As a rectifier it has been used favorably on 15, 25, 60, and 133 cycle currents. The commutator should be set as shown in the diagram, and a fly wheel is to be provided, which will keep up the speed of the armature, when changing from a starting to a running position. Connections should be made as illustrated in the accompanying diagram.



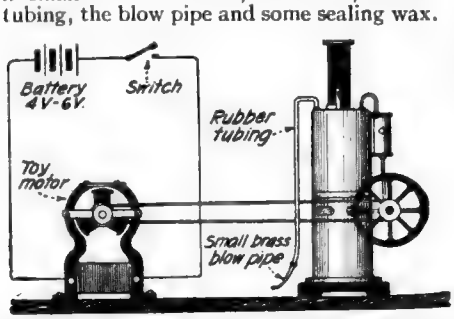


A Very Ingenious Electrical Machine Indeed Is This A. C.-D. C. Apparatus Constructed From a Telephone Magneto. It Is Started as a Battery Motor, by Throwing a Three Pole Switch to the Starting Position, and When the Machine Reaches Full Speed, the Switch is Thrown into the Running Position, When the Armature Winding Will Receive Alternating Current From the Step-Down Transformer; the Machine Will Then Operate as a Synchronous Motor. The Machine Operating in Synchronism Will Rectify the A. C. Thru Its Auxiliary Commutator and Will Recharge the Storage Battery. Many Other Novel Experiments Can Be Carried Out With This Simple, Yet Very Ingenious Machine. Figure Above Shows How Wires Are Run Thru Hole in Shaft to Slip Rings or Commutator.

Contributed by RUDOLPH STERN.

Comprest Air Pump

A large number of experimenters have a small steam engine lying around, which is not doing duty, and could be made to compress air for a small blow pipe. The things needed besides the steam engine are a small electric motor, a switch, rubber tubing, the blow pipe and some sealing wax.



Ever Have a Use for a Small Air Compressor and Wondered Where You Could Get Hold of One at Slight Cost? Here Is a Clever Little Air Compressor Outfit Made Up Out of a Small Electric Motor and a Model Steam Engine.

First take the steam engine and mount it on a board, and in front of it mount the electric motor, it need not be a very powerful one. I used one about 1/16 horse power; then take the rubber tubing and put it in the hole, where water is fed into the boiler, and secure it there with some sealing wax. Fasten the blow pipe to the rubber tubing and connect the motor with the steam engine, but be sure you connect it so that it will run the steam engine backwards or it will create a vacuum instead of compressing the air. I used a Bunsen burner for the source of heat, and have obtained some excellent results with my outfit.

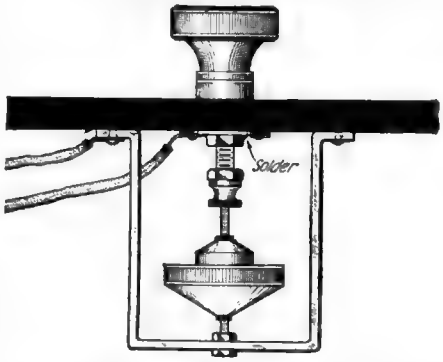
Contributed by JOSEPH BORRE.

A NEW USE FOR TRANSMITTER BUTTONS

Did you ever need a rheostat capable of carrying enough current for an audion circuit, and not knowing where to secure one, or not having the necessary wherewithal, even if you did know where to secure one? Here is one which will cost about $0.00 to construct (if you have the parts), and makes a very effective panel mounting for audion circuits. An ordinary transmitter button is used, and when the knob is turned, a greater or less pressure is exerted upon the diafram compressing or decompressing the carbon granules therein.

Contributed by ERIC WARREN.

Microphone Rheostat



A Simple Way in Which to Make an Adjustable Rheostat for Regulating Small Currents. Turning the Knob Increases or Decreases the Pressure Exerted on the Microphone Button, and the Carbon Grains Within the Case.

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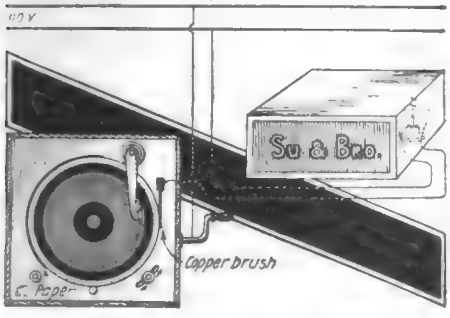
SIGN FLASHER

Having had occasion to use a sign flasher which would take a little more current than the ordinary type, I found that a phonograph answered the purpose very well. Some households had phonographs which are not being used, because they are out of date. Such phonographs can likewise be secured from second hand dealers for a trifle. It is now only necessary to attach to the disk a rather heavy piece of paper, the width of which is equal to the thickness of the turn-table. This is glued firmly in place. Oil fabric is more durable and will answer the purpose, as will a thin strip of hard rubber, which has been bent



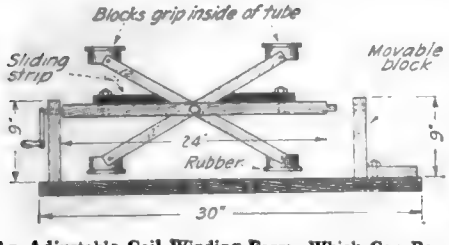
A Simple and Effective Electric Sign-Flasher, Having a Lamp Circuit Opened and Closed By Means of a Copper Brush in Contact With the Revolving Turn Table of a Phonograph or Clock Work Motor, the Ends of the Turn Table Having One or More Strips of Paper Glued Around It.

to the desired shape, by inserting it into hot water; it is then glued to the disk. A copper brush is then mounted upon the phonograph and the terminal is connected to one of the supply wires. The other supply wire is connected to the handle of the phonograph. If it is desired that the flashes occur more rapidly four or five insulating strips may be glued on the disk, and the spaces between them may be made of different widths, and each strip of a different length; in this way the relation of light and dark periods may be changed as desired. It is advisable to operate the phonograph at a low speed, provided that no large current is being past thru the contacts, as this will not necessitate so many repeated windings. On the other hand for heavier currents a higher speed is advisable, to reduce the spark at the break.

Contributed by HENRY T. SU.

A SIMPLE TUBE WINDER

Herewith is a diagram for a tube winder, which I have found to be very efficient. The principle is extremely simple and hardly any explanation, other than the diagram, is necessary. I have found that I am able



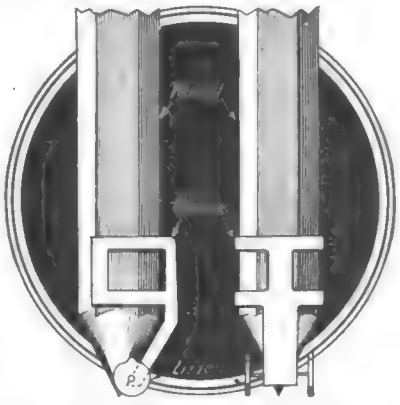
An Adjustable Coil Winding Form, Which Can Be Used in the Lathe or An Improvised Winding Jig Like That Here Illustrated. The Expanding Arms and Blocks Will Adapt Themselves to Various Sizes of Cardboard Tubes in a Jiffy and are Held in Position by Locking the Sliding Strips.

to wind tubes from 3″ in diameter to 7″ in diameter and 24″ long on the same winding spindle, by simply allowing the gripping tongs to collapse, loosening one end-bearing and slipping the tube in place. One of the movable pieces is then forced forward distending the tongs, which have flat blocks fastened to their extremities, which blocks are in turn covered by a piece of rubber inner tube from a tire. This slidable piece is bolted securely and the tube may be wound and removed when completed.

Contributed by ROBERT DUVAL.

DOT AND DASH PENCIL

This device if fitted to a pencil will make a dotted line. In the drawing the lifter is



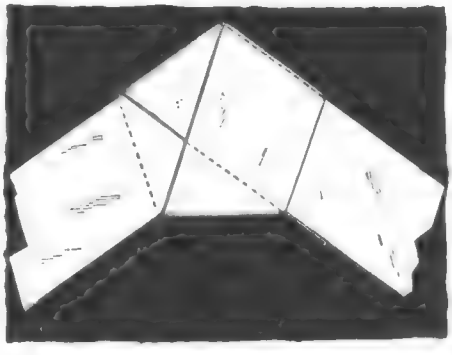
An Automatic Dotting Attachment Which Can Be Placed On a Ruling Pen or Pencil for Draftsmen. Each Time the Projection on the Cam or Lifter Comes Around thePencil is Raised From the Paper.

around to the bump and lifts the pencil to make a space. The wheels are clamped to the shaft so that they go around at the same time, the bump in both wheels being lined up.

Contributed by JOHN BUTLER SWANN.

A FREE-HAND PENTAGON

An almost perfect geometrical pentagon can be made from a strip of paper whose sides are parallel and a little narrower than



Frequently One Desires to Construct a Five-Sided Figure Known in Geometry as the Pentagon—Here is a Simple Method Which Requires No Instrument Whatever, Not Even a Rule. It is Made From a Slip of Paper Tied in an Overhand Knot and Flattened.

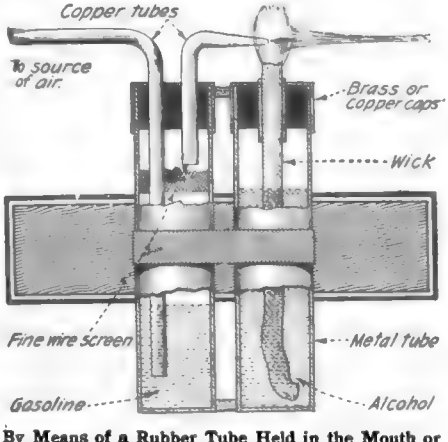
the length of one side of the desired pentagon and seven or eight times as long as wide, by tying the strip into an ordinary overhand knot, flattening the knot as it is being drawn tight.

Contributed by WALTER KEITH MILNE

SUBSTITUTE BLOW-PIPE

One day having occasion to use a blow-pipe and being temporarily without a Bunsen burner, I constructed the following apparatus. As the drawing shows the construction clearly I think an explanation is not necessary. This blow-pipe will generate a flame hot enough to melt glass and kindred objects. If a hotter flame is desired a few moth balls (Naphthalene $C_{10}H_8$) may be added to the gasoline.

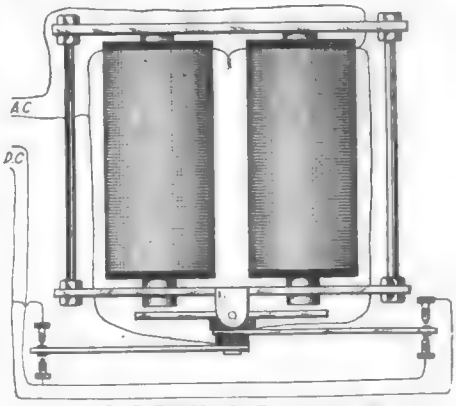
Contributed by DONALD H. NEWTON.



By Means of a Rubber Tube Held in the Mouth or Else Supplied With Air From the Blower, Air and Gasolene Are Forced Up and Thru the Fine Nozzle at Left, Giving a Hot Flame.

A. C. TO D. C. RECTIFIER

Having often desired to charge a storage battery and finding that the ordinary vibrating rectifiers were far from efficient, as only



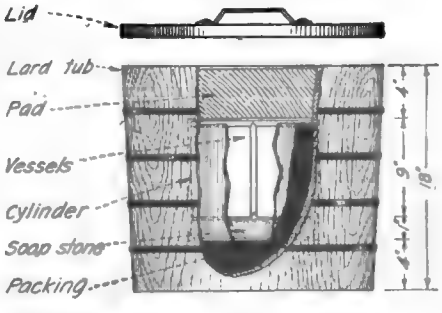
An A. C. to D. C. Rectifier for Battery Charging, etc., Constructed From a Polarized Telephone Ringer. It is Usually Advisable to Connect a Capacity Across the Contacts to Absorb the Sparks.

a half cycle was usually made use of, I constructed a vibrating rectifier from an old telephone bell ringer which I found gave excellent results, the vibrators themselves never missing when once properly adjusted. The circuit diagram is all that is necessary to elucidate it, but for the benefit of the experimenters, I would say, that I mounted upon the rocker arm two pieces of spring brass about 1/16″ thick, to which were soldered small silver contact points. Sparking at these points is not strong enough when a small battery is being charged, to necessitate the shunting of the contact points with a condenser, but for heavier work it would undoubtedly be best to do this.

Contributed by ERNEST PUCHI.

A FIRELESS COOKER

The accompanying sketch shows how to construct a fireless cooker. First pack wool felt or any insulating material in an out-



Fireless Cookers Are Always in Great Demand Especially in Warm Weather, and the Accompanying Text and Illustration Show How To Build a Very Good One, and Larger Ones Can Be Made Following Out the Same Principle.

side container to the depth of 4″; line the container with paper before placing the packing. Cover a bucket 9 or 10″ high with asbestos paper, and set this in the center of container; pack around to the top. Cut a piece of hard board to fit snugly around this bucket or cylinder and level with top of cylinder. Make a pad 4″ thick that will fit snugly when the lid is placed on. Make lid to fit inside the container so when a weight is laid on the lid it will compress the pad and no air can get to the cooking. The cooking vessels and soap stone can be procured at any hardware store.

Contributed by C. M. BUCK.

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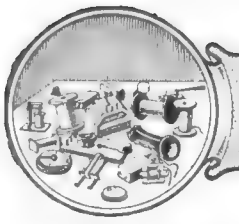
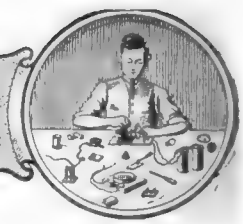


HOW-TO-MAKE-IT



This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

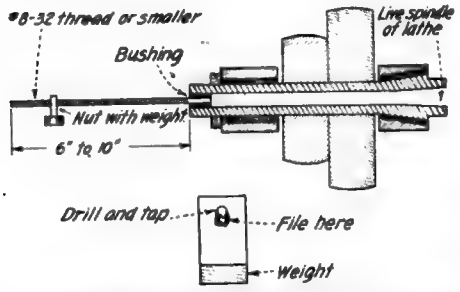
FIRST PRIZE, $5.00

REVOLUTION COUNTER

When winding coils or other objects whose turns are to be measured, it is inconvenient to count them, without the aid of any registering device.

In the absence of a regular revolution counter, an attachment similar to that shown in the drawing may be quickly rigged up.

A length of rod about ⅛" diameter is threaded its entire length and fastened on one end of the object being wound. In the writer's case this was the live spindle of a lathe. The nut is made from a small piece of iron, drilled, tapt and filed, as shown. A small weight, just sufficient to overcome the twisting motion of the screw, is fastened to this.



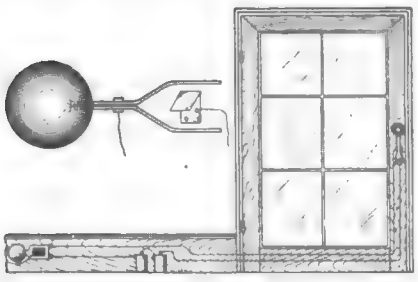
The Nut Travels Along the Threaded Rod Secured to the Live Shaft or Lathe Spindle. The Nut Moves One Thread For Each Revolution.

In operation the nut progresses from one end of the screw to the other as the shaft turns, thus recording the revolutions.

Contributed by W. S. JONES.

ELECTRIC BELL FOR POULTRY HOUSE

Many people have been bothered with night prowlers around and about the buildings. The following plan may be used in installing electric bells, which will immediately sound an alarm. A metal strip of copper is bent around the door-knob shank, and is clamped with a small screw, which is also used as a terminal. Fasten a metal strip to the door and bend it out between the prongs of the strip on the knob. Attach a wire to this strip and run to the electric bell. Now when the knob is turned in either direction the circuit is closed and the bell will ring.



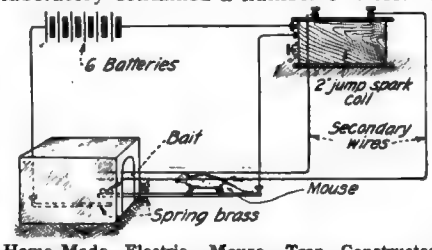
Simple and Effective Electric Bell Alarm for Poultry House and Other Building Doors. Turning the Knob Either Way Rings the Bell.

Contributed by R. WAYNE TAYLOR.

SECOND PRIZE, $3.00

ELECTRIC MOUSE TRAP

The following are plans for the construction of an electric mouse trap, which I made and have been using for some time. As a chemist I have been using a number of different seeds and roots and have found my laboratory contained a number of mice. I have tried every possible way to poison them but to no avail, so I set up my spark coil in the following manner. From the edge of my working table, I screwed a piece of brass about 6" long and adjusted above this piece another one of spring brass, which was very thin about 8" long, with about ¼" space between them. Now we have one wire fastened to the lower brass to the battery, the other wire fastened to the upper piece to one terminal of the coil, and of course another piece of wire from battery to the other terminal of the coil. The brass should be wide enough for a mouse to walk on. Along both sides of the upper brass place the secondary wires of the coil so as to form a railing. Raise the brass strips so that when you bait the top one, the mouse has to walk on the top brass to secure the bait, which forms a contact and inasmuch as he is between the two secondary wires, the circuit when made kills or stuns him and he falls off breaking the contact. If your readers are looking for an interesting trick here it is. The above trap has killed twenty-three mice in two weeks' time. It is advisable to place a housing over the bait to prevent mice attacking it from the wrong side.



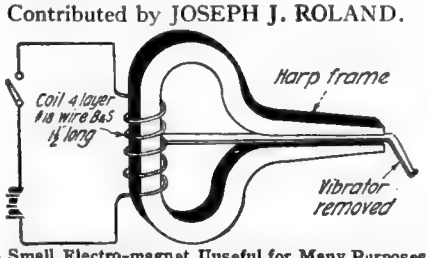
Home-Made Electric Mouse Trap Constructed From a Spark Coil and Spring Brass Contact Strips, Arranged as Shown.

Contributed by WM. A. CROLE, JR.

JEW'S-HARP ELECTRO-MAGNET

Illustrated herewith is a useful electro-magnet made from the frame of an old Jew's-harp. After removing the spring or vibrator, a coil is wound around the ring of the frame as shown in the sketch. This piece of "junk" is useful in picking up small pieces of magnetic metal, such as needles, nails, screws, etc., when they happen to fall in floor cracks, etc., where an ordinary magnet cannot reach them.

Contributed by JOSEPH J. ROLAND.



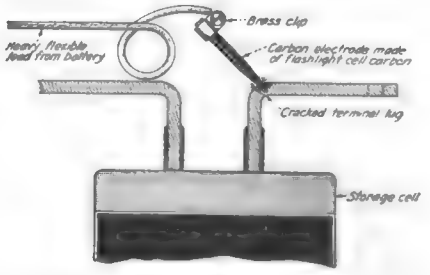
A Small Electro-magnet Useful for Many Purposes is Made by Winding Iinsulated Wire Around a Jew's Harp.

THIRD PRIZE, $2.00

REPAIRING BATTERY TERMINALS IN SITU

No burning outfit, nor even a torch of any kind being at hand, it was decided to repair the lugs by *burning* without removing the cells from position and using the battery current itself, the set being fully charged. An old flashlight battery cell was broken open and the center carbon removed and filed down to a point to serve as the burning electrode. A clip was bent out of a piece of heavy brass sheet and clamped around the end of the carbon by means of a brass machine screw, under which a length of heavy flexible copper wire was also clamped. In use, the electrode was held by a pair of pliers.

About six cells were found sufficient to heat up the electrode to a bright red; the break was then cleaned out and filled in from a piece of heavy sheet lead used as a welding rod; use soldering paste flux.

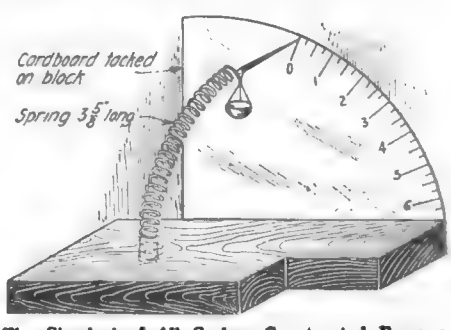


How the Lead Terminal of a Storage Battery Was Repaired by Its Own Current.

Contributed by H. H. PARKER.

A SMALL SCALE

Having secured a coiled wire spring I drilled a hole into a base 1 in. thick and of such size that the spring fitted snugly. Back of the end of this spring I attached a semicircular piece of cardboard so that I could put markings upon the cardboard, and to the spring itself I fastened the cover of an empty glue bottle, as illustrated in the sketch. I then hied myself to the nearest druggist and borrowed his weights for a few moments, while I calibrated the scale and I was quite surprised to see how well it worked.



The Simplest of All Scales—Constructed From a Piece of Spiral Spring, Carrying a Pan and Index at Its Upper Free End.

Contributed by LOUIS CEMEN.

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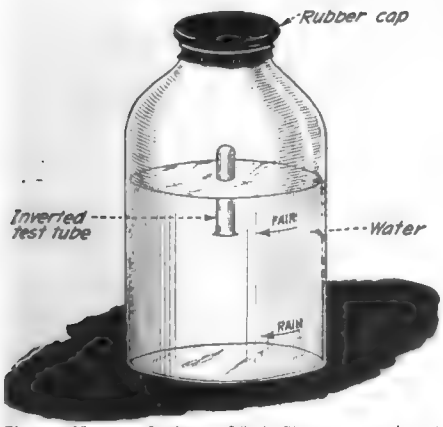
Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

WEATHER INDICATOR

Some time ago I read of the magic lung tester in your *Science and Invention* and accordingly I built one. One day, however, I noted that the test tube inside was down at the bottom of the bottle which I had left open. Some four or five hours later a thunder storm came up. A short time thereafter on again looking at the magic lung tester which I was very much pleased with, I noted that the test tube was again floating at the surface. Putting two and two together I determined that here was a weather indicator, which I should be proud of and to be sure I have found it to work every time. For convenience I covered the mouth of the bottle with a toy balloon, fastened with a rubber band and now whenever I see the test tube at the bottom I know that there is going to be a change in the weather.

Contributed by FRANK M. GORDON.



Simple Weather Indicator Made From a Small Vial or Test Tube Arranged to Float in Water Held in Larger Bottle. When the Test Tube Descends, Unsettled Weather Can Be Looked For.

REPAIRING BROKEN CARBON DIAFRAMS

First of all the broken pieces must be laid on a smooth heavy piece of paper. The paper and the broken parts are to be heavily shellacked and the diafram is allowed to dry thoroly. The paper acts as a clamp and tightens the whole surface. With fine sand-paper remove all surplus shellac and paper until the carbon shows thru and the diafram is ready for use. Do not bend it while working.

Contributed by A. FORD.

EXPERIMENT WITH MERCURY

A chemical that is very interesting and amusing in properties may be prepared by the reaction of the metal mercury upon tin (foil).

The chemical is prepared by placing six or seven square inches of tin foil in a small Hessian crucible, adding four drops of mercury and heating over a steady flame.

Skim the resulting amalgam and pour it out on a small slab, this amalgam may be spread on glass, molded, kneaded, and made into any number of queer objects that the chemist's ingenuity may devise.

Contributed by

HARRY RICHARD CUNNING.

MAKING LABORATORY TABLE TOPS ACID PROOF

First paint the table with a hot solution of the following, giving it 2 coats.

$FeSo_4$	2 parts
$CuSo_4$	2 "
K_4MnO_4	4 "
H_2O	50 "

When dry apply a hot solution of the following, giving it 2 coats.

Aniline Oil C_6H_5, NH_2	6 parts
HCl	9 "
H_2O	50 "

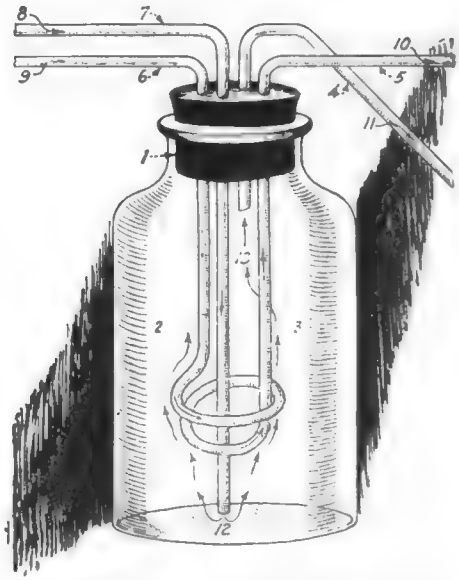
When this is dry rub the surface with linseed oil until a polish is formed.

Contributed by FLOYD JOHNSTON.

SUBSTITUTE FOR A LIEBIG CONDENSER

An easily made and inexpensive condenser can be made from a bottle, a four hole rubber stopper to fit, and about 3 feet of glass tubing. Take a 2 foot length of glass tubing, bend into a U tube, so as to have both ends alike; then make a coil at the bottom of the U tube and put into rubber stopper as illustrated. Bend both ends to a 90° angle. Take a 1 foot piece of glass tubing and make a 90° angle at one end. Put it thru the rubber stopper. Then take a small piece of glass tubing and bend first to a 90° angle and next to a 45° angle. Also put thru stopper. Put stopper into bottle. Connect 8 to the water faucet, 9 to the boiler, and 10 to the bottle into which the distilled water is to go. Attach a hose to 11, and let water run into sink basin. The water (undistilled) goes thru tube 8 out of 12, up around coil and out 13, thru 11, to sink. The steam passes thru 9 into coil, up and thru 10, into the empty bottle.

Care must be taken in operating this condenser as some distilled water may be forced back into the flask if it is allowed to cool and may result in damage.



A Substitute for a Liebig Condenser Can Be Made as Per Sketch, of Glass Tubing Bent to the Shapes Indicated.

Contributed by MILTON SPITZ.

Simple Experiments in Organic Chemistry

By GEORGE A. MacELREE, Jr.

FOR many years, the man or boy who indulges in chemistry for its amusing or educational value, has always stuck to experiments in *inorganic* chemistry; because he believes them to be simpler and of greater interest than any others. However, this is not the case. *Organic* chemistry furnishes some of the most interesting experiments known. Of course, real organic chemistry is a very difficult subject, but you do not need to know all about its principles to do some simple experiments; any more than a man lighting a fire needs to understand the principles of combustion.

As most people know, one of the greatest uses of organic chemistry is the preparation of synthetic perfumes and flavors. Perhaps one of the easiest and most interesting of these for the dabbler is the making of what is termed "artificial oil of wintergreen." This compound is in general use at the present day and can be bought in all drug stores. However, it is far more interesting to prepare it in the home laboratory.

Artificial Oil of Wintergreen

To about two ounces of methyl alcohol, which is commonly called wood alcohol, by reason of its being obtained by the destructive distillation of wood (and this kind can be bought without a prescription), and about as much salicylic acid as will go on a nickel, add 1 c.c. of sulfuric acid and then heat. Allow this to boil for several minutes and the thin colorless liquid will gradually turn brown and become oily in nature. Now cautiously smell the end of the tube and notice the distinct odor of wintergreen. When the liquid has become cool, any extra salicylic acid will crystallize out and leave a clear brownish solution. In the presence of the sulfuric acid, the salicylic acid and alcohol combine to form methyl salicylate, or "artificial oil of wintergreen," which is in common use today, as a flavor and a medicine.

Artificial Extract of Vanilla

Take equal quantities of carbolic acid and chloroform. Heat this in a test-tube and then add half as much by weight of sodium hydroxid, any other alkaline hydroxid will serve as well. Raise this mixture to the boiling point, then let it cool. A white solid will fill part of the tube. Separate this from the liquid, and heat it with wood alcohol. This will form anisic aldehyde, which is the perfume of hawthorn blossoms. Save the liquid, which is very fragrant, and to it add dry acetic acid. Cumarin, the perfume of the tonka bean, will result. This is much used as a substitute for vanilla.

An Experiment in Combustion

One of the most interesting experiments in organic chemistry, after synthetic flavors is one of combustion. This experiment can be done with little or no danger, providing the proper care is given acids. As the reaction is accompanied by some heat, it is best not to hold the tube in the hand.

Into a 6 inch test tube pour about one-half inch of alcohol, it does not matter what kind,

(*Continued on page* 457)

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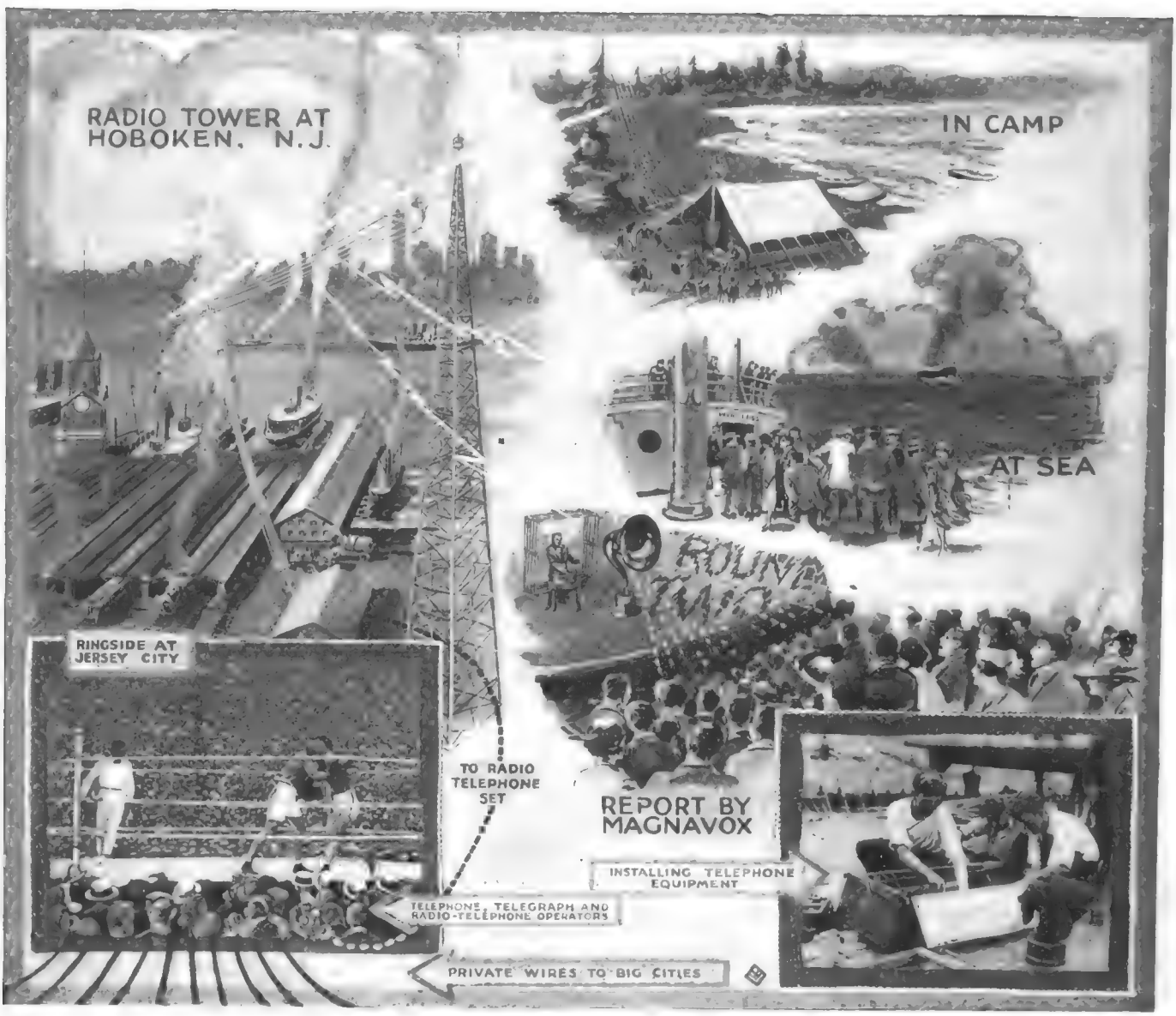
RADIO DEPARTMENT

Dempsey-Carpentier Fight Via Radiophone

By ARTHUR H. LYNCH



The Comprehensive Illustration Above Shows Vividly How the Great Dempsey-Carpentier Fight News, Blow by Blow, Was Radiated by Radio-Telephone from the Lofty Antenna Located at the Lackawanna Railway Terminal at Hoboken, New Jersey. The News Was Received Over a Very Wide Area and it Is Estimated That Several Hundred Thousand People at Least Received the Reports of the Fight in Cities, as Well as in Camp and Far at Sea.

WHEN Referee Harry Ertle reached the count of "nine," nearly one hundred thousand ringside witnesses held their breath and watched eagerly to see if, the intrepid Frenchman could get up before the fateful "ten." He couldn't; you know the rest of the story.

Have you seen one of the pictures of the crowd which was in that huge arena—the greatest crowd which ever gathered to witness a sporting event. Epoch-making, in the history of sport! Yes, and then some! But, that crowd, great as it was, is nothing in comparison to the crowd which followed the fight, round by round, blow by blow, through the medium of the wireless telephone.

Blow by Blow Reports Received by More Than 300,000 People

How It Was Done

The Radio Corporation of America, the D. L. & W. R. R. and the American Telephone & Telegraph Company, installed a wireless telephone transmitting station in Hoboken, N. J., which was connected to a booth at the arena by a private telephone wire.

During the preliminary bouts and during the championship bout itself, the introductions of the fighters and the activities in the ring were telephoned by an observer in the press booth to the wireless station in Hoboken. An operator, at Hoboken, would then repeat the reports into the transmitter of the wireless outfit. The fluctuations of his voice caused various changes in electrical circuits and after being amplified some fifteen million times, were radiated into space from the wires supported by the well-known Hoboken tower, and eventually were picked up and converted again into sound waves at various points thruout the eastern section of the country.

For the transmitting station, six 250-watt-power tubes were used, giving a total output of 1,500 watts. The aerial was

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strung between the high steel tower, shown in one of the accompanying illustrations, and the clock tower of the D. L. & W. R. R. terminal, at Hoboken.

The Absent Audience.

If you take the number of the people, who were in the arena, multiply by three and add a few hundred, you will have a fair idea of the number of those who listened to the returns of the fight. What manner of giant do you suppose it would take to talk in an ordinary tone and have his voice carry to the rim of a circle such a multitude would fill?

Go further still; take some of the crowd you have gathered together and place them in a New York restaurant; place others in a hotel in Philadelphia; others in the Elks' Club in Syracuse; others in various parts of New York State, New England and as far south as Washington and Baltimore. Put some of them aboard ocean liners, two or three hundred miles at sea, and still other groups aboard yachts and small craft in the various harbors and bays of the coast, within a distance of five hundred miles. Put a few here and there, on the farms, and a great number of groups of from one to thirty in private residences of the several states, within the same distance, and you will have a more definite idea of the vast audience which followed the wireless telephone reports, directly from the transmitting station in New Jersey.

In many instances these reports were augmented by other and independent transmitting stations, taking the original data and forwarding it thru the medium of the ether to more distant audiences, which are not taken into account here, and which may well be considered to extend over the entire country. The significance, then, of this wireless event begins to come home to us.

In one instance, alone, there was a crowd of more than one thousand, which received the news, by means of loud-speakers connected to the receiving station, which was set up in an open lot. A radio man, on a millionaire's yacht, which was going up the Sound, happened to pick up the signals, tho he had no previous knowledge that they were to be sent. He was able to connect his radio set to a loud talker and all those aboard the yacht enjoyed the returns.

What is to Follow.

The reporting of the fight was carried on with great success and has been greeted with such great enthusiasm that it has been decided by the Radio Corporation to keep the station intact, tho it was originally installed for the sole purpose of broadcasting the fight reports.

It is to be used for sending out similar news of other important sporting, political, and social events. When his next adversary meets Carpentier, it is thought that an even greater audience will be ready to receive the fight news. For, it must be remembered, that there was but little notice given of the reporting of the event on July 2nd. The day is very rapidly approaching when every home will be supplied with a radio telephone receiving apparatus, to take advantage of just such events as this.

Leaving the reporting of merely interesting events, such as we have been considering, let us remember that another very important service is being perfected by the U. S. Government; it is the sending of weather and market reports to the farmers by wireless telephone. This service is proving to be a very popular one. Many of the farms are now following the schedules, which these telephone stations follow.

During the past few months, in addition to the distributing of news, on the comparatively high power which we have been considering, other services have been instituted, notably in the large cities, where wireless telephone transmitters were used to transmit phonograph music and even vaudeville. Individuals have taken it upon themselves to send out music at certain hours, so that those within range may listen to it. In two or three instances, radio companies have undertaken the installation of wireless telephone transmitting stations in theatres, and the entire performance may thus be followed by any one, who goes to the trouble of setting up a simple receiving station.

The editors of SCIENCE AND INVENTION as well as the editorial staff of our sister publication *Radio News*, received the news of the great prize fight, blow by blow, thru wireless telephone receiving sets connected up to the antenna on top of their building at 233 Fulton Street, New York City. One of the interesting features of the reception was that two distinct sets picked up the ether-flung messages. Mr. Joseph H. Kraus, field editor of SCIENCE AND INVENTION, operated a three-stage audion amplifier receiving set which was connected to the antenna on the roof, while Mr. Robert E. Lacault, associate editor of *Radio News*, surprised the large number of visitors by picking up the messages on a loop aerial 3½ ft. square, and amplifying them with his 10 step French audion amplifier, the voice emanating in the final stage from a loud talker of the new type provided with a large paper cone diafram.

One good feature of the new paper cone loud-talker is the fact that it does not focus the sound, but radiates it in all directions at once.

List of Articles Appearing in September Issue of "Radio News"

Flying Boat Radio Transmitter — *By Jesse Marsten*

Radio Guides Ships — *By S. R. Winters*

Rectifying A. C. for Vacuum Tubes — *By L. R. Felder*

I. C. W. for the Amateur — *By G. Lewis*

Measuring the Characteristics of V. T's — *By L. Lease*

Construction of Choke Coil, Two-Step and Honeycomb Panel — *By P. Jessup*

British Fliers Use Radio

The photograph herewith shows the inside of an English wireless station at the Northolt Aerodrome, with General Salmond receiving radio telegraph and radio telephone messages from a squadron of Bristol fighting planes. These experiments took place during the recent rehearsal for the air pageant, and when this photograph was taken the airplane pilots were also being given their instructions via radio from Group Captain Hereson, stage manager of the pageant.

The development of radiotelephony and telegraphy for use in communicating between airplanes as well as between airplanes and their ground stations, is being rapidly developed, and the American air force has been using the radio phone or wireless speech transmission apparatus for several years. The radio apparatus for transmitting as well as receiving on board airplanes owes much of its success, if not the major part of it, to the remarkable development and perfection in the past few years, particularly during the World War, of audion amplifiers and transmitting tubes. Vacuum tubes, for transmission of undampt radio telegraph signals as well as for radiophonic messages, are now available on the American market for amateurs and experimenters as well as for the regular radio companies, so that a wonderful impetus has been given to the application and development of radio.

We are only at the beginning of the road—the future will see more wonders year by year.

The Photograph Above Shows the Interior of a British Wireless Station at the Northholt Aerodrome, With General Salmond Receiving Radio-Telegraph and Telephone Messages From a Squadron of Bristol Fighting Planes in Flight. The Planes Were Also Given Orders and Directions From the Officers Thru the Radio-Telephone Apparatus at This Station.

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Resonance Wave Coil Antennae

By J. O. MAUBORGNE, Major, S. C.
and GUY HILL, Capt., S. C.

PART II

WHEN the antenna system is grounded, however, as shown in Figure 5, these tuning elements perform their usual functions, and the antenna system, as a whole, must be tuned to be in resonance with the secondary circuit. Placing the wave coil vertically, we now find that we have the equivalent of an ordinary antenna system with the advantage, however, that the antenna system which normally occupies a considerable amount of space, is comprest into almost tabloid form. Raising the wave coil higher above the set, and lengthening the lead connecting the wave coil to the set give increased receiving range.

Fig. 8. A Huge Resonance Wave Coil Used In Signal Corps Transmitting Experiments. The Coil Is Here Shown Wound Around a Telegraph Pole For a Space of About Twenty Feet.

While all the preliminary work with this device was carried out by utilizing single layer solenoids, we have found that *multi-layer coils* will also function satisfactorily, and are of advantage for the *reception of long wave lengths*.

Another point of interest is the fact that the strength of signals received can be considerably increased *by using two or more coils in parallel*, the coils having similar characteristics, and being tuned to the same wave length.

TRANSMITTER

The fact that the resonance wave coils act as remarkably efficient *radiators* of electro-magnetic energy was also early determined. Our first transmitting was done with ordinary receiving coils. It was found, if one terminal of the spark gap associated with an ordinary induction coil were connected to the slider on the wave coil, that the wave coil emitted an electro-magnetic wave, *the frequency of wavelength of which, was determined solely by the position of the slider on the coil*, and the characteristics of the coil between the position of the slider and either end of the coil. The wave emitted by this simple arrangement was found to be one of great purity. With a given coil, used for both transmission and reception, it was found that for a given setting of the slider on the coil, a wave of the same length could be radiated from the coil, used as a transmitter, as that received by the coil when used as a receiving device with the slider at the same point. It was but a step from this early experiment to the enlargement of the resonance wave coil so as to handle the power of ordinary transmitting sets, and to the employment of more modern transmitters of both radio-telegraphy and radio-telephony, for the purpose of applying suitably modulated high potential to the wave coil antenna, and thus producing radiation capable of transmitting signals over considerable distances. We found that the system was equally suitable for the transmission of damped or undamped waves, or, in other words, that we could employ either a high potential discharge method allowing free oscillations to be set up on the coil, the frequency of these oscillations to be determined by the electrical constants of the coil and the position on the coil of the applied potential, or we could impress a high frequency potential on the coil, and adjust the coil, so that its natural wavelength would be the same as that of the source of high potential.

Undamped wave telephone and telegraph circuits are readily adaptable to this type of antenna for transmitting purposes. The generator of continuous waves obviously may consist of a high frequency alternator, an arc transmitter, a vacuum tube transmitter, or any other means for generating high frequency oscillations, the circuits and the design of the apparatus in any of the above systems being arranged, so that a high voltage may be applied to the wave coil. While, as in the case of the use of the wave coil as a receiver, it is to be noted, that it is not necessary to have any antenna or ground connection on the coil, or on the generator of continuous oscillations, nevertheless, it has been found in practise, that far better radiation is obtained, when the transmitter is grounded and the apparatus arranged as shown in Figure 6. As in the case of the receiving apparatus, when the ground is connected to the transmitter, it is necessary, that the antenna system as a whole, including the wave coil, the lead connecting the wave coil to the transmitter, the secondary tuning elements within the transmitter, and the ground connection shall all be tuned to the same frequency or wavelength as that determined by the primary tuning arrangements of the transmitter itself.

The method of reducing the wave coil antenna to practise is shown in the photograph, Figure 7, where an arrangement for transmitting and receiving from a Signal Corps truck is illustrated. The wave coil antenna, consisting of a coil wound on a bakelite tube, slightly over 6 feet in length, and about 6 inches in diameter, with bare

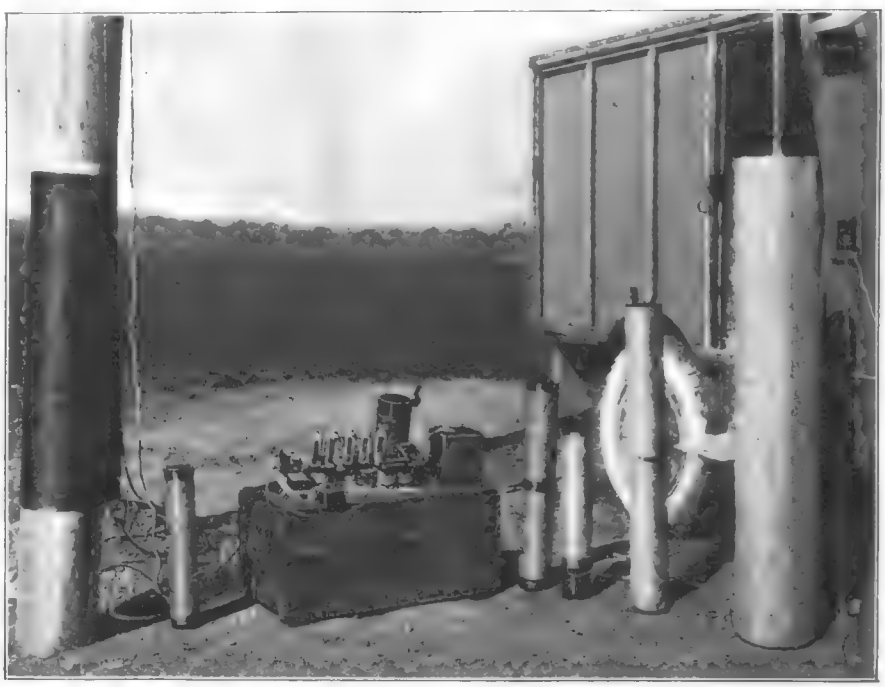

Fig. 9. Various Types of Resonance Wave Coils Used in Transmitting Experiments by the Authors. In the Center May be Seen a Five Bulb Audion Transmitter.

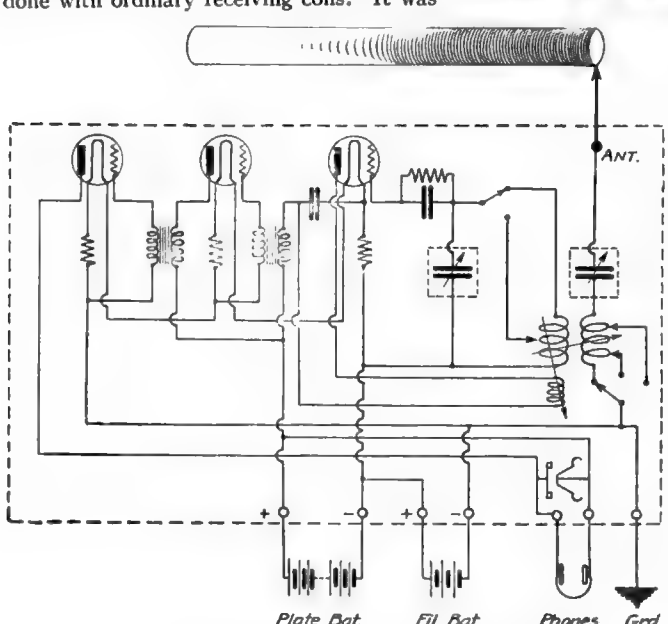

Fig. 5. Tuned System Used With Audion Amplifier and Resonance Wave Coil Antenna. The Antenna System, as a Whole, Must be Tuned to be in Resonance With the Secondary Circuit. Multiple Layer Wave Coils Have Been Successfully Used, as Well as Several Coils on Parallel.

(Continued on page 474)

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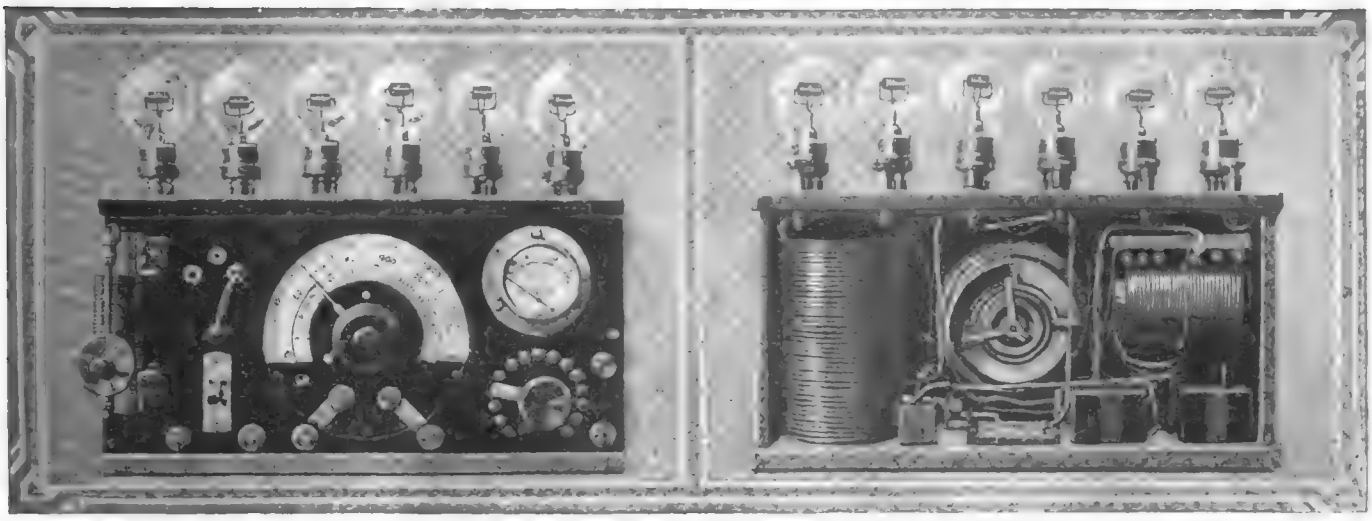
A Radiophone and C. W. Set That Works

By ROBERT E. LACAULT



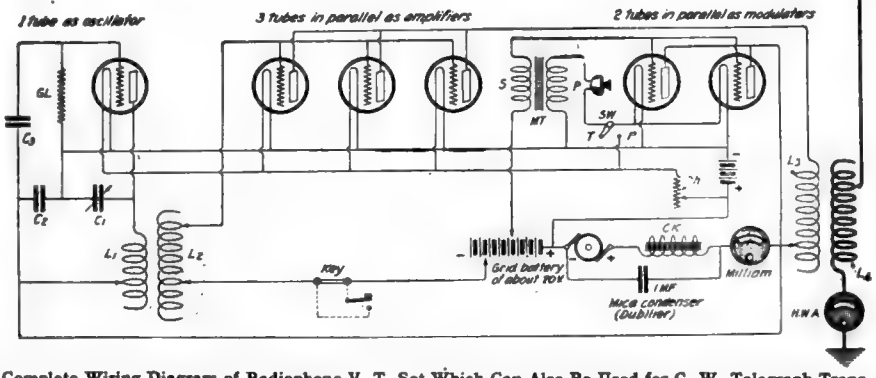
Front View of the Simple Compact Radiophone Set Which Was Built and Used by the Author Very Successfully. Fig. 2.

Rear View of Radiophone Cabinet With Back Removed, Showing Inductance Coils, Condensers and Connections. Fig. 3.

AFTER using tools and knives made of stone, the first men found some metal, and made their tools and knives of this. At the time it was considered great progress, and later these implements were universally used. It was the transformation of the "stone age" into the "iron age."

At the present day there are still some men breaking stones, with what are called "stone crushers," better known in the Radio field as "spark sets." We are at the end of the Radio "stone age," and the newest is the C. W. or "undampt wave age," and, as usual, it is difficult to make everybody take kindly to something new. But remember, it is only the first step that costs, and once that is made, one finds the new thing so great a progress, that he quickly forgets the old, and even dislikes those who still use it, calling them names.

If every Radio amateur would realize this, and adopt the new system, i.e., undampt wave, everyone would be satisfied and great progress would be accomplisht. The reason most amateurs still use spark sets, is because the sparks jumping between the electrodes of a big rotary gap, is nice to look at, and allows them to hear what they send, but they do not realize for a second, how many watts they use for nothing, and if they knew that a 30 to 40-watt C.W. set has a greater range than a 1-k.w. spark set, they would probably stop and think about it real seriously.



Complete Wiring Diagram of Radiophone V. T. Set Which Can Also Be Used for C. W. Telegraph Transmission. Six Bulbs Are Here Shown in Use. Fig. 1.

Besides the power question, there is another one still more important; this is the interference caused by their sets, almost all of them emitting a wave, which ignores completely or in part the lawful decrement.

In any Club, the "QRM" question is much discust, but the members personally do not do much to reduce it. The answer is, C. W., or Radiofone.

To construct an undampt wave or radiophone transmitter it is merely necessary to have a panel and a cabinet and mount inside some V.T. inductances, condensers, and a few other things, and there you are, the only delicate point being, to use only the proper dose of each to make it right.

It is the purpose of this article to give the value of the parts to be inserted in the cabinet, in order to produce an instrument that will send signals 250 miles, and speech about half that distance regularly, under good conditions; that is to say, with a good aerial, free from the screening effect of nearby trees or buildings, and having a good ground. By *ground* we do not mean gas or water pipes, altho these may be excellent, but zinc plates with as large a surface (several square yards) as possible, or wire cloth buried in the earth about one or two feet; in wet earth, if possible.

Of course, a much greater range may be obtained with the set here described, and even some freak distances have been covered but the normal range is about as above mentioned. In fact, the voice has been reported clear at a distance of 750 miles, several times, but it cannot be said that the set has such a range regularly.

The circuit used by the writer, who has had a great deal of experience with vacuum tube sets, keeps the wave-length constant, in spite of the change of natural period of the aerial, caused by the swinging of the flat-top or the lead-in, a feature specially important in winter. Any amateur who has listened to C. W. or phone, has noticed that the tone changes and the signals sometimes suddenly vanish; this is due to a small change in the capacity of the aerial, which, with the sharpness of the undampt waves, changes the wave-length a few meters, thus slightly detuning the set and compelling the operator to constantly tune the receiver. In this set, the antenna has no effect upon the wave length radiated.

As may be seen in the diagram, Fig. 1, one tube is used as master oscillator, two

(*Continued on page 476*)

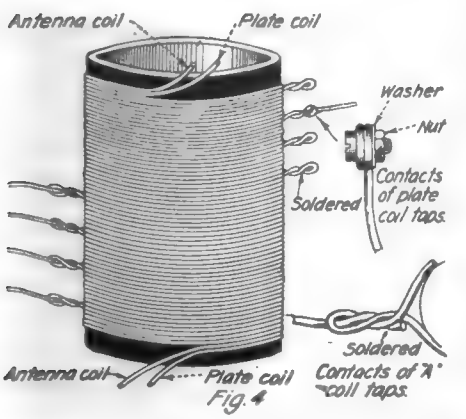


Fig. 4

This Diagram Shows Clearly How the Antenna Inductance Is Wound, the Plate Coil Winding Being Wound Side by Side With the Antenna Winding.

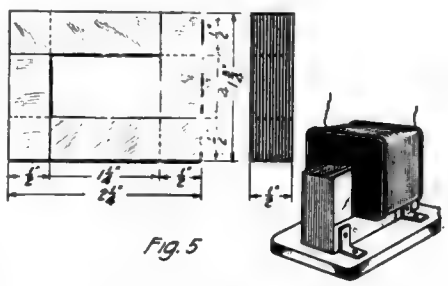


Fig. 5

Details Are Here Illustrated Showing How the Closed Iron Core Choke Coil Is Constructed. These May Also be Purchased from Radio Supply Companies. The Same Arrangement as Here Suggested Can be Employed in Building a Modulation Transformer as Well

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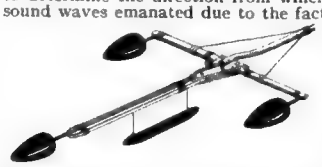
LATEST PATENTS

Under Water Sound Detector.

(No. 1,378,960 Issued to Joseph Warren Horton.)

Heretofore it has been quite difficult to determine the direction from which sound waves emanated due to the fact



that locaters and sound detectors were invariably mounted rigidly to a vessel, so that it was necessary, in order to discover the position from which the sound emanated, to change or alter the course of the ship. With this invention, however, such action will be unnecessary. Essentially it consists of a sort of T shaped buoyant cross-arm, upon which at the three extremities are mounted microphonic detectors. This is towed behind the vessel by means of a cable, to which cable a weight is attached sufficient to cause this T shaped body to remain submerged slightly below the surface. Connections from the microphone communicate with the electrical apparatus on board, and when it is necessary to determine the exact position of the source of sound, the operator listens to two of the microphones and then by varying his controls until the intensity in both these microphones is the same, by simple triangulation he can determine the position of the sound-source. He then chooses another pair of microphones and again triangulates.

Hair Singeing Machine.

(No. 1,378,137 Issued to Warren A. Ross.)

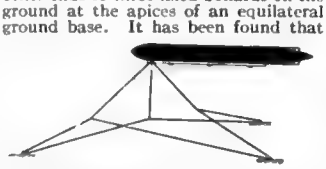
Many of us have often gone into barber shops and noted the rather peculiar odor of burnt hair. Those who believe in hair singeing, claim

that it is superior to hair clipping, in that it closes the hair and seals them against loss of vitality thru the hair shaft. Others know better. This hair-singeing machine comprises a handle similar to an ordinary pair of hair clippers. The interior of the handle has a hollow passage thruout its length. The comb portion at the bottom is drawn thru the hair of the patient, causing the hairs to extend upwardly and to come in contact with the heated ends of a tray or plate, which is kept hot by means of resistance wires thru which electric current flows. The singed hairs fall in the rear of the open head of this device, where an air suction causes them to be rapidly delivered to an exhaust thru the handle, and thence by means of a tube to a position where the exhaust fan is located. Odors of course are expelled simultaneously.

Mooring for Airships.

(No. 1,378,341 Issued to Robert Alexander Frazer and Leonard Frederick George Simmons)

Usually for this purpose it has been proposed to employ three mooring cables of equal lengths connected at one end to a common swivel or connection upon the airship and at the other ends to three fixed bollards on the ground at the apices of an equilateral ground base. It has been found that

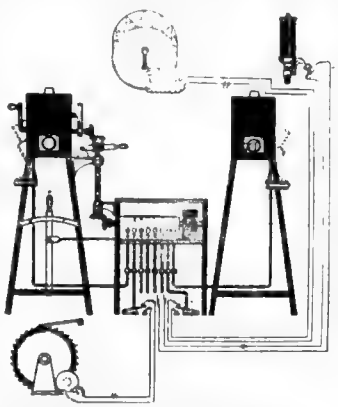


with this method the airship in a heavy wind causes at least one cable to slacken and the ship rides down upon the other members upon which greater tension is now put, the tendency being sometimes to snap the cables or stress the airship. In this invention the patentees employ a plurality of cables, each cable passing over one or more swiveling pulleys carried by suitable braces or fittings.

Stage-Effect-Controlling Device.

(No. 1,379,654 Issued to Frank R. Summermeyer.)

In order to produce automatically such effects as sound, calls, colors, etc., in relation to a motion picture and in exact synchronism with it, the inventor has devised a contrivance similar to the player-piano device, in which a reel of perforated tape moving at a slower speed than the film, but governed by the movement of the film,

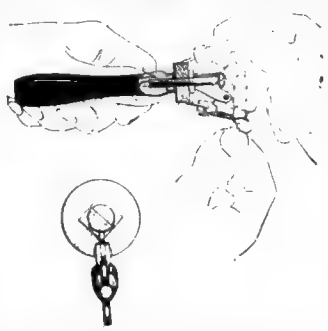


passes over a series of elongated openings, which set of openings communicate with controls of small bellows-like structures. An exhaust fan causes these bellows to operate when the perforated portion of the paper strip passes over one of the orifices. These bellows devices close electrical contacts which communicate with the various instrumentalities emitting sounds, as naturally it is possible to produce as at the present day.

Phonograph Needle Sharpener.

(No. 1,378,597 Issued to George William Mayer.)

This is a rather ingenious little contrivance, whereby everyone who possesses a phonograph employing metallic interchangeable needles will be able to resharpen them. Essentially it consists of a handle upon the forward end



of which is clamped a grinding disk, whose perifery forms the grinding edge. Protruding from the center of the handle, an arm is arranged which is provided with a bearing and socket, forming a means for holding the needle with the point of a phonographic needle at a definite angle with regard to the grinding surface of the wheel. It is then merely necessary for the operator to do one of three things in order to sharpen a phonographic needle. He can either hold the grinding wheel and the handle stationary and swing the needle holding arm around the grinding wheel, or he may rotate the grinding wheel and keep the needle stationary, or he may rotate both in opposite directions.

Sound Reproducer.

(No. 1,378,835 Issued to Robert W. Charlton.)

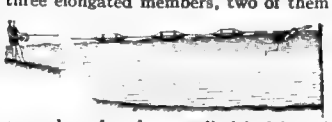
Hitherto it has always been found necessary to either employ two reproducers or to change the angle of

the reproducer for functioning properly upon vertical and lateral cut records. With this device such a thing will not be necessary and the position of the diafram does not have to be changed. Broadly, the invention comprises a special stylus bar, connected as usual to the diafram at one end, and having a pivotal connection with the perifery of the sound box. This stylus bar is of a duplex nature, one end of is perfectly straight and the other is bent to an angle. Simply shifting the sound box thru an arc of but a few degrees, without changing its angular relation, with regard to the face of the record, will cause another needle to come into position; one needle with the straight stylus bar being adapted to play the lateral cut records, and the other with the angular stylus bar for vertical cut records. For eliminating unnecessary wear a rod mounted upon a spring sustains the weight of the sound box.

Life Saving Apparatus.

(No. 1,380,026 Issued to Henry W. Walters.)

Due to the yearly toll of lives resulting from drownings, many inventors have attempted to overcome this loss. The invention described herewith is one of such. There are three elongated members, two of them

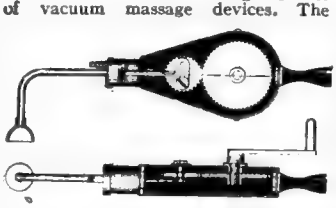


cone shaped and one cylindrical jointed together, so as to form a cylindrical body pointed at both ends. A rod passes thru this hollow set of bodies joining them together rigidly and has eyelets on both ends. The entire buoy is covered likewise with three or four longitudinally arranged ropes, enabling a drowning person to secure a firm grip. Several of these buoys may be connected upon the same life line which is pulled by a life guard or swimmer toward the drowning individual. The reel which holds the rope is also made buoyant, so that should the life guard, who holds the reel, drop it, in attempting to assist the other guard to bring to shore the rescued persons it will float. In view of the fact that the buoys are narrow, elongated and pointed at either end, it is a relatively simple matter to tie one end of the life line to the rescuer's suit, who then swims out unreeling the rope and drawing the buoy with him.

Intermittent-Vacuum Massage-Machine.

(No. 1,378,922 Issued to George A. Ward.)

Here is a new device along the lines of vacuum massage devices. The



machine is operated manually by a crank or may be operated by a motor if so desired. A rubber cup shaped applicator is applied to a portion of the skin of the person to be massaged and a crank is rotated. This in turn serves to operate an eccentric mechanism, thru a series of gears whereby a pump-plunger is reciprocated in the cylinder. Consequently it will be seen that upon the down stroke of the pump plunger, the suction at the mouth of the applicator causes the skin to be drawn into it due to a partial vacuum formed, and at the up-stroke of the plunger, the skin is released. It will be seen, therefore, that the applicator alternately sucks and releases the skin. A needle valve is provided for regulation of the suction which allows some air to enter so as to prevent such a powerful effect at the mouth of the applicator.

Pencil.

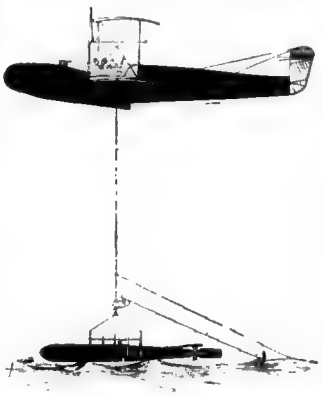
(No. 1,378,174 Issued to Ferdinand Kaiser.)

This is a rather clever invention comprising a barrel and a tubular magazine fixed within a holder. This freely received pointed leads which have been fastened rigidly to a metallic grip. Near the lower end of the pencil a slot is arranged which allows for the discharge of the pointed leads, but this end is fitted with a springlike tongue which prevents the leads from being forced backward after they have once been ejected from the holder, and should the point of the pencil break, it is a simple matter to get rid of the broken end by simply bending the metal magazine backward and forward, and forcing the next lead of the magazine into writing position.

Aircraft Torpedo Dropper.

(No. 1,379,788 Issued to Andrew Jackson Stone.)

It is of great importance in maritime warfare to attempt launching self propelled or automobile submarine torpedos from aircraft by lowering them into the water. When they reach the water, or are but a few feet



from the surface, the cable is usually severed. It is important that the airplane which holds them suspended from that cable shall not be jarred to any great extent. Should it be allowed to remain dangling from the cable and strike the water before being released, serious damage might result to the plane. In accordance with this idea the inventor has proposed a means whereby it is possible by means of a pair of tongs, to release the torpedo at the predetermined point, and yet to recover the cable if desired, or cut the cable. A sounding device can tell the aeronaut exactly when the torpedo is near the surface of the water.

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Scientific Humor

"Can't You Take a Joke?" the Contributor Asked the Joke Editor.—"What is the secret of success?" asked the Sphinx.

"Push," said the Button.

"Never be led," said the Pencil.

"Take pains," said the Window.

"Always keep cool," said the Ice.

"Be up to date," said the Calendar.

"Never lose your head," said the Barrel.

"Make light of everything," said the Fire.

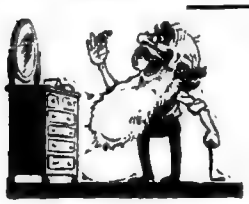
"Do a driving business," said the Hammer.

"Aspire to greater things," said the Nutmeg.

"Be sharp in all your dealings," said the Knife.

"Find a good thing and stick to it," said the Glue.

"Do the work you are suited for," said the Chimney.—*Mario Cioffari.*



He's Lucky—We Never Do!—Jiggs: "Prof. Dingus has at last discovered the missing link."

Jaggs: "Where did he find it?"

Jiggs: "Under the bureau, I understand."

—*John H. Schalek.*

Artless Art.—HE—"Girls are better looking than men."

SHE—"Why, naturally."

HE—"No, artificially."

—*F. D. Hensel.*

Hoarse Sense.—"You are hoarse this morning. You must have caught cold in the theatre last night."

"Shouldn't wonder. I sat in the Z row (zero)."—*Donald Glasson.*

Or Chemical Affection.—Tom: "Harry is dreadfully in love with that blonde."

Jim: "Yes, and his family thinks it's a case of hypnotism."

Tom: "I don't know but I think that it is a case of chemical attraction."

—*Mortimer Eckstein.*

Letter Go, Boys.—HE—"You're good at anagrams, aren't you?"

SHE—"Sure, spring one."

HE—"Here it is. Take away my first letter, take away my second letter, take away all my letters, and I am still the same. What am I?"

SHE—"You're a postman, you poor fish."—*John H. Schalek.*

The Automobile imParts Good Advice.—"Brighten up," says the Headlight.

"Don't be a knocker," says the Cylinder.

"Keep cool," says the Fan.

"Don't blow too much," says the Horn.

"Be a good mixer," says the Carburetor.

"Avoid friction," says the Bearing.

"Re-tire early," says the Casing.

"Cut out the noise," says the Muffler.

"Be a good felloe," says the Wheel.

"A quick turnover is what counts," says the Crank.

"One good turn deserves another," says the Connecting Rod.—*Robt. P. Fish.*

Chemical (?) Affinity.—GRUFF—Why is Molly cool (molecule)?

BUFF—Because she has a Tom (atom).

—*V. Vincent.*

First Prize $3.00

And Is Never Recovered.—Professor: "Under what combination is gold most quickly released?"

Student: "Marriage, sir!"

—*W. Shaw.*

Hadn't Joint 'Em Yet.—PROFESSOR OF BIOLOGY—"What can you tell me about the joints?"

NEW STUDENT—"I don't know much about 'em sir, I'm a stranger in this town."

—*Louis L. Lakatos.*

"I'll be dammed," said the River.

"I'm on the run," said the motor.

"I've been exposed," said the film.

"Well! I'll be darned," said the stocking.

—*Emil Malz, Jr.*

So That's What Busts 'Em.—TEACHER—"What are we studying today?"

STUDENT—"Infernal combustion engines."—*Norman M. Dahl.*

Call the Bootblack.—Electric light in dark place, "Here's where I shine."

—*Emil Malz, Jr.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

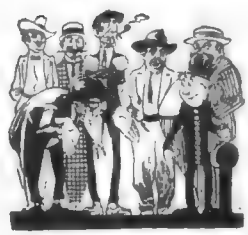
He Registered 100%.—FIRST STUDENT—"How was the examination?"

SECOND STUDENT—"Just like Edison's Questionnaire."

FIRST STUDENT—"What do you mean, 'Edison's Questionnaire'?"

SECOND STUDENT—"Oh, I couldn't answer any of them."—*Barnard Wolfe.*

A Racial Uplifter.—Jack: "My brother takes up French Spanish, Italian, Hebrew, German and Scotch."



Jill: "Goodness, when does he study?"

Jack: "Study! He doesn't study. He runs an elevator."

—*Donald Glasson.*

Is a Miss as Good as a Mile Here?—SILINDER—"What are you doing these days?"

PLUGG—"I make some hits with lots of misses."—*Emil Malz, Jr.*

The Art of Mnemonics.—On entering a post-office to send a registered letter to her son in China an old German woman found that she had forgotten his address.

She told the clerk of her predicament. "Ach, it sounds like an auto some vay," she told him.

"Toot-toot?" he asked. She shook her head. He then turned to his assistant.

"Joe," he inquired, "what noise does an automobile make?"

"Honk-honk," was the reply.

"Ach, dots it," said the woman and went away satisfied.—*Cecilia Callahan.*

But Will He Go?—Ein: "Jaggs has invented a wonderful clock."

"Stein: "What's wonderful about it?"

Ein: "Well, beginning at ten o'clock, instead of saying 'Coo-coo' it says 'Time-to-go; ain't you gotta home?'"

—*John H. Schalek.*

Checkmated.—"We had quite a game up at the boarding house last night."

"Poker?"

"No, the landlady was going to lick one of the boys for not paying his board, I tried to checker, she jumped me, crowned him, and told us both to move."

"Did you do it?"

"Chess."—*Nelson Shepherd.*

Those That Get No Ice Are Boiled.—The other day I was talking with a farmer from Southern Arizona. He said it got so hot down there that he had to feed his hens cracked ice to keep them from laying hard boiled eggs.

—*Fred Carlton.*

A Hot One.—PROF. (in physics class)—"John, why didn't you complete the last experiment on the tempering of steel?"

STUDENT—"Well sir, I began heating the steel as you said and the first thing I knew the strip of steel lost its temper, and I could not complete the experiment, while it was in such a state."—*George Mueller*

We Pronounce it Rank.—JACK: "Say Joe, how do you pronounce C-A-S-T-O-R-I-A?"

JOE: "Castoria."

JACK: "Nope. The doctors pronounce it harmless."—*J. P. Parker.*

Perpetual Motion Again?!X.—CUSTOMER: "That fountain pen you sold me wasn't any good."

SALESMAN: "What was the matter with it?"

CUSTOMER: "The other day when writing with it, it stopped writing all of a sudden."

SALESMAN: "Did you fill it?"

CUSTOMER: "No, it said self-filling on the box."—*Freeman Campbell.*

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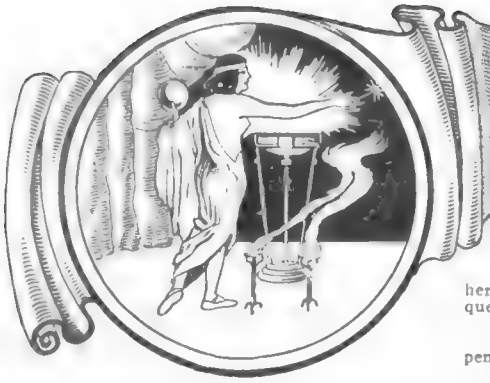

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Magnetism Versus Gravity

(1128) Chas. L. Harrell, Richmond, Ind., writes:

Q. 1. If you place a bar magnet upon a pan of a scale and its weight is so much and you place another magnet underneath its weight increases.

Therefore are scales an instrument for weighing or for measuring the attraction of the earth to the object?

A. 1. Weight is directly proportional to the density of an object, and depends on the gravitational pull of the earth. If this gravitational pull can be overcome, the object has no weight. Hence, if a means of overcoming gravitational pull is exerted upon the object, this object will be suspended and float and have no action upon a balance which only records the gravitational pull of said object. It is therefore, the pulling force upon our bulk and density which causes weight.

Operating Turbines on Drinking Water Supply

(1129) Michael J. Jones, New York City, N. Y., asks:

Q. 1. Why could one not operate turbines with the water supply coming to the city from Croton Lake?

A. 1. In answer to your recent communication, we would like to inform you that no doubt the Croton water, which comes into New York City, could be harnest and converted into electrical power thru the medium of several hydro-electric plants. This, however, would tend to reduce the water pressure in the city which we believe is low enough as it is now, only between 60 and 80 pounds per square inch.

Q. 2. Would the water be made undrinkable?

A. 2. As long as the generator is kept absolutely clean and no oil manages to get into the interior it will have absolutely no effect on the water as far as its drinking quality is concerned, but this is almost impossible of attainment.

Solidifying Water

(1130) Felix Kohn, Paris, France, asks:

Q. 1. Is there a way of solidifying water so that after it is set in motion by revolving a container of the liquid it could be hardened and form a paraboloid?

A. 1. Why go thru all the trouble of attempting to solidify water while in motion? Why not take a thin mixture of plaster of Paris and water and rotate this until it sets, whereupon a paraboloid will result.

This has been proven and in fact, several experimenters have made reflecting telescopes in such a manner as this.

You can solidify water by freezing it.

Storage Battery Paste

(1131) N. C. Kelly, Hudson, Mich., writes:

Q. 1. Please give composition of the paste used in storage battery plates.

A. 1. We would advise that the following have been found to be effective and are widely used in acid storage batteries.

Litharge, which is one of the lead oxides, is used for the negative plates while red lead, more oxidized than the above, is used for the positive. A paste is made with dilute sulphuric acid, one part to four of water. This sets very quickly.

Another method (James).

For the positive plate:	
Red lead	85%
Litharge	10%
Asbestos	4%
Powdered Carbon	1%
For the negative:	
Litharge	94%
Asbestos	4%
Sulphur	1%
Carbon	1%

New Radio Devices

(1132) Clide W. Hall, Webster City, Ia., asks several questions in regard to new radio inventions.

A. We would state that there are large numbers of devices which could be invented which would yield the inventor money. One of the greatest would be a practical vacuum tube detector, or other form of detector, which can be used for the reception of wireless messages, both damped and undamped. Needless to say, apparatus of this nature will have to be reasonable in price, much more so than the present valves, and work as efficiently, if not more so.

A phonographic recorder which can be used with all types of disk phonographs, would be very ideal and large sale for the same should be found. A good type of amplifier or otherwise microphonic, should have a ready market if produced at a reasonable sum.

There are two ways of looking at inventions, one is to make good apparatus of high value, and charging of course a good price, or to make smaller apparatus much cheaper than that on the market at the present day, which will work as efficiently, and will sell to the multitude of amateurs utilizing radio.

Undoubtedly, Mr. Hoxie's invention will meet with great favor now that high speed radio-communication is definitely established, but only a few of the large commercial stations will be able to employ this method, as it involves considerable expense to install and maintain, altho on the other hand expense of keeping the generator going is greatly reduced. We always hold that the best form of an invention will be one, in which large quantities can be sold at reasonable profits, and thus become definitely established. The perfect detector not being here as yet, any work which may be successful, will more than repay any research work on the part of the inventor.

Mixing Chemicals

(1133) Alfred Hodges, Alma, Montana, asks:

Q. 1. In one of the articles in *Science and Invention* you speak of mixing chemical parts. Is this parts by weight or volume?

A. 1. When any article speaks of parts, it means parts by weight, and if you use 154 parts or grams of chloride of gold you will add to that 2,000 parts or 2,000 C. C. of water, inasmuch as one C. C. of water weighs one gram.

Q. 2. What candle-power is equivalent to one watt of electrical energy? What is the difference between 2-phase and 3-phase currents?

A. 2. Generally, one watt produces one candle-power in tungsten filament lamps, altho some of the newest type lamps develop a greater efficiency than that. Two-phase and three-phase current has been described time and again in this journal, and we would advise that you peruse some of the back issues, or else refer to some good book on the subject, such as Timbie and Higbie's works on Alternating Currents.

Aerial Sled

(1134) Ralph Hoh, Appleton, Wis., writes:

Q. 1. Will a 7 H.P. motorcycle engine drive an aero-sled?

A. 1. A seven H. P. engine will easily drive an aerial sled. The propeller should be about 3 to 3½ feet in diameter, dependent upon the thrust, either belt drive or chain drive may be employed, and some form of clutch should also be inserted.

Closed or Open Core Transformer Best?

(1135) J. E. Hall, Seymour, Ind., asks:

Q. 1. Which is more efficient for radio-transmitting purposes, a closed or open core transformer?

A. 1. A closed core transformer is far more efficient than the open core transformer, for radio or other purposes. Therefore, if you build a closed core transformer having the same current consumption as the open core transformer, you will get a much greater output and transmitting range from the closed core type under similar conditions.

Nickel Plating Outfit

(1136) Elmer E. Adams, Chicago, Ill., inquires:

Q. 1. How can I make a small nickel-plating outfit? I have the battery and tank but don't know the composition of the solution.

A. 1. A nickel-plating outfit consists essentially of a jar containing an anode of metallic nickel, and a bath of the following solution:

Nickel and ammonium sulfate, 10 parts; boracic acid, 4 parts; distilled water, 175 parts. Perfect cleanliness of the surface of the article to be plated is an essential to success.

This cleansing is generally accomplished by boiling in a strong solution of caustic potash. The article should then be washed and never handled, except with a wire. It is then scratch-brushed under water, which renders the surface bright.

Resistance Problem

(1137) Clarence B. Burge, Cambridge, Mass., says:

Q. 1. I have a 7V. 30A. generator. I desire to maintain a current of 16 amps. What resistance must I have?

A. 1. The external resistance must be 0.43 ohm.

The resistance may be made out of any suitable resistance wire. By obtaining the resistance per foot of the wire, you will be able to determine exactly how much wire is necessary.

German silver, iron, or any other resistance wire may be used.

Can Animals Foretell Weather?

(1138) Ralph E. Belsinger, Cincinnati, Ohio., asks:

Q. 1. What is the scientific opinion today of the ability of animals to foretell weather?

A. 1. The scientific opinion of today is that animals cannot foretell seasonal weather, either by the thickness of the fur or in any other manner.

Q. 2. It is the opinion of some that birds see more clearly because they can detect ultra violet or infra red illuminated objects. Is this so?

A. 2. It is probable that the keen sense of sight of birds is due to a greater cultivation of that very important asset. Birds, as you know, have constantly been using their eyes to a greater extent than man. A sailor trained at sea and traveling the sea for years, will have a much clearer sense of sight and much keener vision than us landlovers. We do not believe that the infra-red or ultra-violet rays have much to do with the keen sense perception of lower animals, altho when tests were made on dogs, it was discovered that they react to ultra-violet rays.

Size of Transformer Cores

(1139) R. R. Bassett, Joplin, Mo., asks:

Q. 1. Please give size of iron cores for transformers from 100 watts capacity to 5000 watts.

A. 1. We are giving herewith size of cores for different capacity closed core transformers.

Capacity in Watts	Length	Breadth	Thickness & Width
100	10	6	1
200	10½	6½	1
300	11	6½	1.2
400	12½	6¾	1.3
500	14	7	1.4
600	14¼	7¼	1.6
700	15	7¾	1.7
800	15	7¾	1.8
900	15	8	1.9
1000	15	8¼	2
2000	17½	8¾	2½
3000	18	9½	2½
4000	18	9¾	2¾
5000	20	10½	3

Highest Voltage Produced

(1140) Landis R. Bradfield, Paullina, Iowa, writes:

Q. 1. What is the main difference between motor and dynamo?

A. 1. The difference between a motor and a dynamo is in the broad sense of the term that the dynamo generates electrical current and the motor consumes electric current generated and giving forth mechanical power. In the larger machines, there is a radical difference in the winding of a motor and a dynamo. A motor can never properly be called a dynamo, unless it is used as such. There are, however, machines which can act either as dynamos or motors.

Q. 2. What is highest voltage produced by man?

A. 2. The highest voltage produced by any electrical machine is way up in the millions (about 60,000,000), this being attained by the use of Tesla transformers.

Q. 3. Will a shock from a 110 V. circuit prove fatal? What is the highest voltage to which a person can be subjected?

A. 3. Currents at a pressure of 110 volts have been known to fatally injure adults. This, however, will depend greatly on the amperage and the area of applied contact. Some people can place a finger inside a lamp socket with impunity and only a slight stinging sensation, resembling needle pricks, results.

Currents at a pressure of several million volts can and have been past thru the body, provided the frequency is sufficiently high. Take, for instance, the article on "Cold Fire" appearing in the November, 1919, issue of this journal.

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How Would You Like to Earn $83 a Day?

The true story of J. F. James, the shipping clerk who became president of a great manufacturing company. What was the secret of his success?

By Richard W. Samson

THE other day I spent a few precious hours with Mr. J. F. James, President of the Mascot Stove Manufacturing Company, of Chattanooga, Tennessee.

Fifteen years ago he was working as a shipping clerk in a stove foundry for $9 a week. Today he is making $25,000 a year, or $83 a day. As Mike Murphy, the famous college trainer, used to say—"You just can't beat a man who refuses to be beaten."

Somehow, whenever I meet a man like this, and learn the story of his life, I am doubly glad that I am an American.

For this is truly The Golden Land of Opportunity. "The barriers are not yet erected which shall say to aspiring talent—'Thus far and no farther.'"

Few men have started life with as barren prospects as J. F. James. Born in the mountains of East Tennessee, forced to go to work before he had completed his education, he might easily have fallen into the rut of mediocrity and stayed there.

But one day, glancing through a magazine, he came across an advertisement which appealed to him so strongly that he read it twice and then tore it out of the magazine to read again.

It told how thousands of other men had won promotion through spare time study. How they had trained themselves to do bigger things! How they were ready and waiting when Opportunity came!

THAT day J. F. James made a resolution. He said that what others were doing, he could do! So he tore out that familiar coupon, marked it, signed it, and mailed it to Scranton. Though he did not fully realize it at the time, he had taken the first step along the Up-road to Success.

So it came about that J. F. James studied while other men wasted their time shooting pool or playing pinochle or watching the clock. They are still doing it today—worn, discouraged men who cry out that Fate is against them and that "they never had a chance."

Doomed forever to small wages, fighting a losing fight against poverty, missing the really good things of life, they cannot understand how "Jimmy" James got ahead.

J. F. JAMES
Just 40 years old and earning $25,000 a year. To young men he says:—"Stop killing time. Study the theory of your work. Then you're bound to succeed."

"I didn't make a drudge of myself," said Mr. James the other day. "I had time for baseball and everything that seemed worth while. I had just as much fun as the other fellows, but instead of wasting time, I turned it into gold through my I. C. S. course.

"Every hour I invested in study has paid me better than any other investment I ever made.

"It has brought me a large income—the satisfaction that goes with success—the money to buy anything I want—a good home and an automobile for my wife and children—the esteem of all my friends. I feel that I owe the I. C. S. a debt that I can never repay. They made my success possible."

WHAT about you? Are you satisfied to stand just where you are? Or do you really want to be somebody? It all depends on what you do in your spare time.

"There is not a man in power at the Bethlehem Steel Works today," says Charles M. Schwab, "who did not begin at the bottom and work his way up. They won by using their normal brains to think beyond their manifest daily duty."

And one of these executives earns a million dollars a year!

The difference between a successful man and a failure is almost always a matter of training.

As Andrew Carnegie said:—"Although my whole works were to be burned down, it wouldn't be a fatal blow—if I still had my organization, my trained men."

You can be one of these trained men. You can get the training you need right at home in spare time.

For thirty years, the International Correspondence Schools have been helping men out of routine drudgery into work they like—helping them to win advancement, to have happy, prosperous homes, to know the joy of getting ahead in business and in life.

In offices, mills, shops, stores, factories—in every line of endeavor—I. C. S. men are "the first to be hired and the last to be fired."

How much longer are you going to wait before taking the step that is bound to bring you more money? Isn't it better to start now than to wait five years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want.

Here is all we ask: Without cost, without obligating yourself in any way, mark and mail the coupon. It takes but a moment of your time, but it is the most important single thing you can do today! ***Do it right now!***

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Without cost or obligation, please explain how I can qualify for the position, or in the subject *before* which I have marked an X in the list below:—

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☐ Electric Lighting & Rys.	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING
☐ Telegraph Engineer	☐ Show Card & Sign Ptg.
☐ Telephone Work	☐ Railroad Positions
☐ MECHANICAL ENGR.	☐ ILLUSTRATING
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ Private Secretary
☐ Toolmaker	☐ Business Correspondent
☐ Gas Engine Operating	☐ BOOKKEEPER
☐ CIVIL ENGINEER	☐ Stenographer & Typist
☐ Surveying and Mapping	☐ Cert. Pub. Accountant
☐ MINE FOR'N or ENGR.	☐ TRAFFIC MANAGER
☐ STATIONARY ENGR.	☐ Railway Accountant
☐ Marine Engineer	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Com. School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILES
☐ PLUMBING & HEAT'G	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation ☐ Banking
☐ Text. Overseer or Supt.	☐ Agriculture ☐ Spanish
☐ CHEMIST	☐ Poultry ☐ Teacher
☐ Pharmacy	

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When a man like you must fight

You probably haven't had a real fight since you were very small. Settling a dispute with your fists is the last thing you'd think of. And yet, a time may come when you will *have to fight*.

Suppose you saw a rowdy in the act of insulting a woman. Could you look the other way? No, sir, you'd want to step right up and teach him the lesson he deserved. But *could* you? A quarrel might lead to the challenge, "Come outside and fight." Could you do it and hold your own? Or suppose you were attacked in a deserted street after dark. You'd *have to fight!*

Remember, those two fists of yours are the best weapons—they're always with you, always ready.

Marshall Stillman will teach you boxing and self-defense in your own home.

In his course, the fundamentals (hitting, guarding, ducking, feinting, and footwork) are easily learned, because you start by practising simple movements before a mirror—the breast stroke in swimming, holding out your hand for a coin, etc. Subconsciously you are led into striking heavy blows, guarding, ducking, feinting, etc., just as though you had a real opponent before you.

When you've mastered the fundamentals, you're taught every good blow in the ring—how to land it, and how to guard against your opponent's counter.

Then comes *shadow boxing*. Marshall Stillman has combined such scientific blows as the Jack Dempsey Triple, the Benny Leonard Triple, the Mike Donovan Double, etc., into three lively rounds for daily practice.

You're also taught 12 wrestling holds and 15 jiu jitsu holds.

The course includes a set of muscle building exercises. The Colon Exercise (a remedy for constipation) and Synthetic Breathing (a lung developer and aid in curing nervousness).

And you get free an illustrated history of 69 great boxers with "inside" stories seldom heard outside professional circles.

Sent Free on Approval

The entire course is sent on approval. If not satisfied, you return it in 10 days. If you buy it, you have till the 15th of the following month to pay ($5 in the U. S., $6 in Canada, $7 in foreign countries). Send no money, but mail the coupon now to

Marshall Stillman Association, Suite 1421-J. 461 Fourth Ave., New York

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Suite 1421-J. 461 Fourth Ave.. New York

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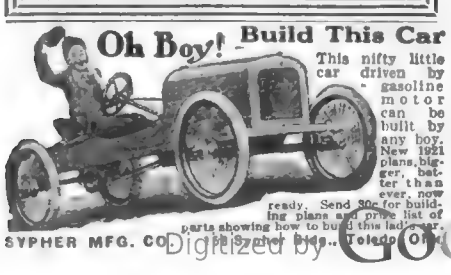

Oh Boy! Build This Car

This nifty little car driven by gasoline motor can be built by any boy. New 1921 plans, bigger, better than ever, now ready. Send 30c for building plans and price list of parts showing how to build this last year.

SYPHER MFG. CO. Toledo, O.

Editor's Mail Bag

(*Continued from page 429*)

can't be quite so good as the real article, you with the mind that can delve into such a store of knowledge acquired by all sorts of experience, should be able to conceive something very near as good and possible to make at home.

Wireless 'phoning is too expensive for us "bugs" in the present way, but if we could make a high frequency generator whose field current could be influenced by the voice through a microfone, that would be great. Why can't it be done?

FRED POST.

Auburn, Ill.

(*We believe upon carefully checking up past copies with present ones, it will be found that the amount of text which we publish now far exceeds the amount we publisht at any time before. We even publish more How-To-Make-It and Constructor Department matter now than we did before, if the matter is carefully checked up.*

"Who wants to make a violin?" So far we have heard from over 1,500 readers who requested the names and addresses of manufacturers of varnishes and accessories, and if we have heard of this many, there must be thousands more who did not take the trouble to write to us for the reason that they probably knew the sources from whom to buy the necessary material.

We are not aware of the fact that we do not publish enough on how to make common electrical apparatus, as almost every issue contains a good assortment.

We have never publisht how to make an Alexanderson high frequency generator for the simple reason that, first, this is a patented article on which basic patents exist and the builder would infringe upon these patents if he built the alternator. Secondly, no ordinary amateur unless he had a commercially equipt machine shop could possibly think of building the Alexanderson high frequency generator as he would not have the necessary equipment. Thirdly, the cost of building one of these would be prohibitive. For $20 it is possible today to build a wireless telephone that works well. We have publisht some of the best vacuum tube telephone outfits. It is possible today to make a good outfit, even using only one vacuum tube, so why build a high frequency generator, whose capacity anyway is too large for the ordinary amateur.

—EDITOR.)

STAR SHELLS LIGHT A 5 MILE AREA

The success of the star shell in the war has promoted exhaustive tests by our Navy Department to the end of producing shells of different sizes which will take the place of the searchlight to a great extent. A star shell does not give the location of the ship firing it so plainly as does the beam of the powerful searchlight now in use.

Shells have been developed which function almost perfectly when fired from guns of three inches or smaller. From the larger calibers the new shells do not work so well. The reason is that an exceedingly great discovery has been made. A flashless powder has been developed. It is used to propel the star shells from the guns. With the larger guns there is more of a flash with this powder than with the smaller guns. However, with the smaller guns, it is so slight as to almost be unnoticeable. The new star shells are said to be able to keep an object in focus in a bright light nearly five minutes at a range close to five miles. It is evident from this, what tremendous advantage it possesses over the searchlight.—*Graser Scheinheimer.*

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Saxophone Book Free Tells you when to use Saxophone — singly, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

Free Trial You can order any Buescher instrument and try it six days without obligation. If perfectly satisfied, pay for it on easy payments to suit your convenience. Mention the instrument interested in and a complete catalog will be mailed free. (28)

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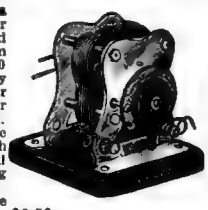
A New Addition to Our Big Line of Motors **$3**



Designed to supply a highly efficient motor for driving mechanical toys and smaller models. Runs on 2 or 4 dry cells or on 110 volts A. C. through a toy transformer. Commutator made from drawn copper bars insulated with mica. Specially treated gauze brushes. Complete with switch for starting and stopping or for reverseing the direction.

This motor can also be secured without switch for $2.50.

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is a combination Mannheim, Log-Log, Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.

Price with 16 page Instruction Book, $1.50. Leatherette carrying case 50c extra. Catalogue Free. Your money back if you are not satisfied.

GILSON SLIDE RULE CO. Niles, Mich.

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A Prominent Physician says:

"Every home should have a Renulife Generator for the treatment of ailments such as Neuralgia, Neuritis, Sore Throat, Kernels in Neck, Cramps, Headache, Stiff Neck, Muscular Soreness, Rheumatism, Paralysis—in short, pains of all kinds."

SATURATE YOUR BODY WITH HEALTH BUILDING ENERGY

Steady your nerves, tone up your muscles, drive out aches and pains and know the joy of perfect health. In your own home you can have the quickest and most direct way of treating nervous disorders, painful chronic diseases and of building bodily vigor. You may give yourself this wonderful, curative upbuilding treatment with

Soothing, effective treatment for headache, neuralgia or pains in any part of body.

Brings a surge of warm, fresh blood to restore normal conditions.

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The penetrating, stimulating Violet Ray brings a surge of warm, fresh blood to any part of the body to which they are applied. Vigorous circulation flushes out impurities, reduces inflammation and congestion and almost immediately relieves pain. It helps nature build healthy new tissue and permanently strengthens the weak, diseased areas. See coupon for list of ailments successfully treated.

An Invigorating Tonic

The RENULIFE VIOLET RAY improves and enriches the blood, relaxes tense nerves and muscles and brings a feeling of strength, health and well-being. A ten minute treatment gives definite relief in cases of nervousness.

This wonderful curative agent is painless, shockless and without jolt or jar. It utilizes the current from your electric socket, but changes it into a gentle, stimulating, penetrating, tonic ray. You get results formerly obtained only at great expense in hospitals and sanitariums. Investigate at once. Our book tells the whole wonderful story.

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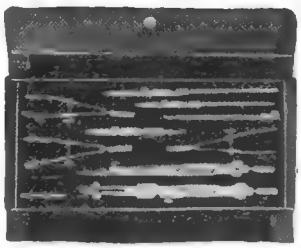

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BOOK REVIEW

HIGH FREQUENCY APPARATUS. Design, Construction and Practical Application. By Thomas Stanley Curtis. Clearly illustrated. Cloth covers, size 5" by 7½", 269 pages. Publisht by the Norman W. Henley Publishing Co., New York.

The alternating current leads in the prominent developments of the day and restricting it to high frequency, we find there the culmination of its achievements and the great promise for the future.

Wireless telegraphy, electric, therapeutical and X-ray apparatus, physicians' equipment, the Tesla investigations all come under the title of this work.

Electro-therapeutics receive considerable attention, plant culture by high tension current, and high frequency circuits, the construction of electrical apparatus for such display, etc., are all treated adequately and the construction of a welding transformer brings us back to more mechanical topics. One chapter is devoted to hints for the electrical entertainer. The book has a very good index and is illustrated as required.

ELECTRICITY SIMPLIFIED. A Treatise Covering the Practice and Theory of Electricity. By Dr. T. O'Conor Sloane. Fully illustrated. Cloth covers, size 5" by 7¼". Publisht by the Norman W. Henley Publishing Co., New York.

This book has had many readers in the past and the enterprising publisher has had it brought up to date by additional matter, which has increased the number of pages so that the book now contains 218 pages.

We particularly commend in it, its numerous analogies, rules for polarity, its adequate index and the illustrations.

STANDARD ELECTRICAL DICTIONARY. 1920 Edition. Revised and Enlarged. By Dr. T. O'Conor Sloane. Profusely illustrated. Cloth covers, size 5" by 7¼", 767 pages. Publisht by the Norman W. Henley Publishing Co., New York.

The Standard Electrical Dictionary by a quantity of new matter, embodied in what is termed "Part 2," has been increased to a volume of 767 pages with 477 illustrations. To bring it well up to date, the work of the original author was supplemented by additional matter written by Prof. A. A. Watson of Brown University.

Much attention has been given to wireless telegraphy and the last developments in X-ray work, in furnaces, new lamps, lifting magnets, and other topics of the most recent developments have been included. It is now a very full work of references' and we take pleasure in recommending it to our readers.

We shall hope to see other additions from time to time in order that its long and honorable career may be prolonged for the benefit of many future readers.

WATER POWER ENGINEERING. By F. F. Fergusson, A.M. Inst. C.E. Profusely illustrated. Cloth covers, size 4" by 6½", 116 pages. Publisht by the Isaac Pitman & Sons Co., New York.

The text of this little work covers 116 pages if we include the index and bibliography, so it will be seen that it is not a very heavy book. It is devoted to water power plants and says a good deal about turbines of different types. The old fashioned overshot and undershot water wheel are not treated, as presumably the author considers them definitely displaced by the turbine and reaction wheels.

The book is attractively printed on very nice paper and has numerous illustrations; mathematics are used in simple form as required for elucidation.

THE END OF THE WORLD. By Joseph McCabe. Fully illustrated. Cloth covers, size 5" by 7½", 267 pages. Publisht by the E. P. Dutton Co., New York.

The title need not be taken by the reader as implying the supernatural, as this book is mainly devoted to astronomy and possible star changes. It covers the variations of the stars and as regards the end of the world, this really means the fading out of cosmic energy and the cessation of cosmic forces. It is of course theoretically discust and treated, but the reader should not imagine that he is going to be frightened—as the title may lead one to believe—by the occult.

Looking at the index, we do not find the name of Einstein included, which we certainly expected to see in such a book.

(*Continued on page 454*)

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Book Review

(*Continued from page 452*)

THE SCHOOL OF ELECTRICITY. Book Ten. Part One. Single Phase Armature Winding. By W. E. Hennig. Numerous illustrations. Cloth covers, size 7″ by 10¼″, 62 pages. Publisht by the Electroforce Publishing Co., Milwaukee, Wis.

This very fully illustrated monograph deserves our fullest commendation. The subject is clearly presented, the diagrams of windings are particularly to be praised, and it is fair to say the illustrations fully approximate half of the pages. Where mathematics are used, they are all of simple description.

We observe a presumable oversight in shunting in consecutive formulae from the exponential nomenclature to full notation. Our own preference would have been to adhere to exponentials thruout. The formulae are all so simple that they can be employed by anyone.

HOW TO WIND DIRECT CURRENT ARMATURES. By W. E. Hennig. Profusely illustrated. Cloth covers, size 7″ by 10¼″, 205 pages. Publisht by the Electroforce Publishing Co., Milwaukee, Wis.

What we have said about "Book Ten of the School of Electricity" applies to this one. It is a relief to find books so clearly printed, so well illustrated and so comprehensive in the ground they cover, as this. A clearly given diagram of wave winding for instance tells more about it than would the most elaborated verbal description.

The practical method of making coils are given quite elaborately with excellent illustrations. Just as in the other work there are no formulas given that could not be used by any student. A particularly valuable portion of the book is devoted to useful information and formulas of the appendix.

Like the other book, it has quite an adequate index.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION.—1918. Fully illustrated. Cloth covers, size 6″ by 9¼″, 612 pages.

While this is the official annual report of the Smithsonian Institute, it really contains much matter of general interest. Helium, 20th century physics, the properties of matter under high pressure, the problem of radio-active lead, history in tools, the latter by Dr. W. M. Flinders Petrie, are examples of the subjects treated.

One chapter is devoted to an appreciation of Dr. Langley's work. Dr. Langley is the pioneer in aviation and it is really pathetic to see how near the great scientist came to solving the problem, whose final solution was reserved for the bicycle manufacturers of Ohio. Unfortunately the internal combustion engine had not been developed to a point where it could be successfully used, until the very last of the experiments.

An interesting note in conjunction with Dr. Langley's work is that Mr. Glenn H. Curtiss flew over 150 feet with the old engine and propellers, and then installed an 80 horse-power Curtiss motor and direct connected propellers, with which numerous successful trips were made.

PHYSICS OF THE AIR. By W. J. Humphreys, C.E., Ph.D. Well illustrated. Cloth covers, size 6½″ by 9½″, 665 pages. Publisht by the Franklin Institute, Philadelphia, Pa.

Meteorology and general phenomena of the atmosphere are the subjects touched upon in this elaborate book which is published under the auspices of the Franklin Institute. An authoritative aspect would be given to it by this fact alone, were such needed, but the authorship of the book is enough to give it full weight.

A cursory inspection of its pages impresses the observer with its great adequacy of treatment. The subject of lightning is quite typical and very interesting in its presentation. A few paragraphs on the subject of ball lightning, one of the great mysteries of electrical phenomena, give a really rational statement of the possibilities, and doubts affecting the study of this phenomenon. We note that the author states that persistence of vision may have something to do with repeated ball lightning discharges, something which the reviewer has long believed.

But thruout the work will be found so many points of interest, that, while the science and mathematics of the subject are given fully, the book retains the aspect of literary value very well, so we can certainly recommend it to our readers.

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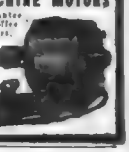

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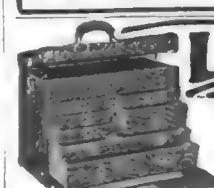

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THE ATOM. By Albert C. Crehore, Ph.D. Cloth covers, size 4¾" by 7½", 61 pages. Illustrated. Publisht by the D. Van Nostrand Co., New York.

The atom is a small but important unit in the world and, for so insignificant a thing, is exciting much attention. The present work goes absolutely into the mathematics of the subject, avoiding however, the very highest mathematics, and when we consider its liberal use of formulae, the book is really surprisingly readable.

Giving masses the dimensions of a velocity goes to eliminate the gram from the C. G. S. System and to express the dimensions of the mass in length and time.

While the book can be read with the omission of much of the mathematics, it will not be adequately studied without them.

OPPORTUNITIES IN CHEMISTRY. By Elwood Hendrick. Cloth covers, size 5" by 7¾", 102 pages. Publisht by Harper & Brothers, New York.

Of late years, chemistry has become not only of vastly increased importance in everyday life, but its range has so increased and covers such everyday subjects, that it appeals more and more to the unscientific man.

"Opportunities in Chemistry" is, of course, supposed to tell what means a young man should take, to make it his profession. Accordingly, we find in the 11 chapters, different subjects treated,—soap, general chemical processes, formulaes, iron and steel and others. It makes good reading and certainly will do much to excite interest in chemistry as a means of establishing a career.

SCIENTIFIC SELLING AND ADVERTISING. Fourth Edition. By Arthur Dunn. Leather covers, size 5" by 7½", 116 pages. Publisht by the Industrial Publishing Co., New York.

This very clever little book is well worthy of recommendation to aspiring salesmen. The author certainly knows how to advertise including the advertising of his own abilities. In this book, he has elaborately analyzed what may be termed the science of selling and advertising, using schedules where necessary, dividing his work with a large number of captions so as to give it the analytical aspect, and using such clear print, that this in itself is a recommendation.

All thru the personality of the human being is taken into consideration and the ethics and psychology of the profession are given very adequate treatment. The successful salesman has the commercial world at his feet. We believe that this little book may do much to help many aspirants for the all important position of conducting the sales end of commercial business.

INTRODUCTION TO GENERAL CHEMISTRY. An Exposition of the Principles of Modern Chemistry. By H. Copaux. Translated by Henry Leffmann, A.M., M.D. Cloth covers, size 4¾" by 7¼", 195 pages. Publisht by P. Blakiston's Son and Co., Philadelphia, Pa.

The title of this book tells its story. It is definitely an introduction to chemistry. It starts in with the atomic theory, valency, organic and other formulae; radio activity, atomic degradation, and radio-active transformers are quite liberally treated.

Properties and theories of solutions, chemical affinity and thermo-chemistry, including endothermic reaction and the subject of endothermic compounds are given space. We are surprised to notice the absence of colloid chemistry, something which is now attracting great attention,—but otherwise the book has been brought thoroly up to date and is very compact in size. It is worthy of recommendation to the old time chemist, to be read at leisure moments, as a means of bringing his notions up to date.

WEATHER BOOK FOR THE GENERAL READER. By Joseph H. Elgie. Illustrated. Cloth Covers, size 5" by 7½", 251 pages. Publisht by the Wireless Press, Ltd., of London, England.

From the Wireless Press of London comes this book on meteorology. It is fair to say that its subject is pretty thoroly covered in the fifteen chapters, whose titles, however, it is needless for us to give.

It is interesting to notice that three chapters towards the end are devoted to supposed weather signs. Some of us feel that by observation of the sunset and general signs, we can beat the Weather Bureau at prophesying. For such people undoubtedly these three pages will be valuable reading.

One trouble of course with the supposed weather signs, is that what may be the sign of one kind of weather in a certain locality, will indicate another kind in some other section,—especially if we take into consideration the prevalent winds, but these three chapters are certainly interesting and instructive.

The book is illustrated and the picture of the "Thames" in olden times frozen over, is really quite interesting to the person who knows his London. This picture shows a "Frost Fair" of old times, and is the reproduction of an old print. A weather vocabulary follows the text and an excellent index is appended.

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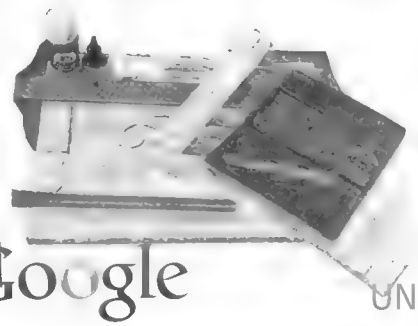

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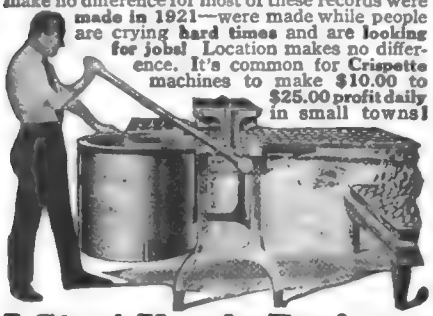

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The Magic Crystal Gazing Globe

By PRESTON LANGLEY HICKEY

(*Continued from page* 435)

While it is very possible for the young mechanic, who has a knowledge of wood-turning to make this pedestal himself, if you are not familiar along these lines, go to some wood-turning establishment, and you can have a good pedestal turned out at a nominal cost. The size of the pedestal will depend entirely upon the size of the globe that you use.

A cabinet may be made from an ordinary wooden box, small and yet plenty large enough to contain the manipulative apparatus of the illusion, leaving enough room for you to operate the light rheostats easily. Four audion rheostats are connected with the batteries and also with the lights. The rheostats when turned slowly, cause the lights to come on very faint, and grow brighter by slow degrees. An ordinary atomizer bulb, the tube of which goes to a bottle provided with a two hole stopper and thence up thru the table top, and the bottom of the pedestal, terminating just under the center of the globe is shown. This bulb of course, is connected as shown in the diagram to the bottles containing household ammonia and dilute hydrochloric acid the smoke from which reaction is perfectly white. Between the table legs in the illustration, one can see the drape as well as the approximate length that this should hang below the apparatus box; the drape should not extend all the way around the table. It may cover at least a quarter of the back on each side, but plenty of room should be left for the hands to work uninterruptedly. Now for the actual operation.

When the lights have been extinguished, and someone asks a question, turn one of the rheostats slightly, at the same time squeezing the smoke bulb, and a faint glow will appear, which reflecting up thru the smoke will give the impression of a highly colored vapor. Slowly increase the light intensity and your pressure on the bulb, and at the end, the globe will be a seething mass of beautifully colored vapor. For more vapor the bulb is prest and released several times. In the improved form by simply releasing the air bulb the crystal is freed and the operation can be repeated with another light. Two or more lights can also be used, and the most beautiful color combinations imaginable can be thus created.

All that the operator needs in order to work this illusion successfully is a good imagination; that is to be quickly able to form an answer within your mind to any question that might be put to you.

While the following is not necessary, if you can afford to purchase a genuine crystal, three quarters the size of the globe that you use, o that it could sit within the globe on a smaller pivot of the big pedestal, it for some inexplainable reason makes the illusion stand out at its best, and the effect is much better, although it can be very successfully worked without the genuine crystal within the globe. I performed it with the globe alone for years, and it was only recently that the idea of having a real crystal connected with the séance occurred to me.

In closing I have but to say, that if you wish to build something that will create fun and amusement, something that will positively increase your popularity—for every individual who can make the least claim whatever at being a "medium" is popular—an illusion, that is practical and can be built for a very reasonable expenditure of money, build yourselves one of these *crystal gazing* outfits. You will never re[illegible]

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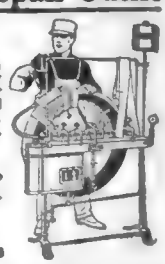

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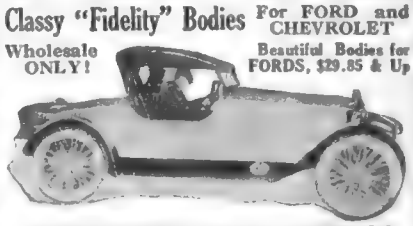

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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Simple Experiments in Organic Chemistry

By GEORGE A. MacELREE, Jr.

(*Continued from page* 441)

and to it add an equal amount of sulfuric acid. As the acid is the heavier of the two, it will sink to the bottom. Now drop into the tube several crystals of potassium permanganat and wait a little while. In about a minute, sparks will begin to fly within the tube and a veritable sham battle will ensue, accompanied by a loud crackling. The flames will be so violent that they will appear to penetrate the glass and appear without the tube. This action will continue for quite a time. Do not attempt to empty the tube before action has ceased, because some of the alcohol might take fire and a catastrophe result. The effect will be heightened if this experiment is performed in a dark room.

Spontaneous Combustion

An equally interesting experiment is one of spontaneous combustion. Mix equal quantities of common sugar and potassium chlorat, and place this mixture in a basin or other high-walled container, as the action is vigorous when it starts. Now cautiously add a few drops of sulfuric acid to this and stand away. In a few seconds a loud crackling will be heard and the basin will appear to be in a state of eruption. Suddenly a purple flame will dart up with all the brilliancy of flashlight powder, and will as quickly die down. This is caused by the sugar robbing the chloric acid of its oxygen, and burning up the carbon. Naturally this theft makes a strong action and produces heat. This heat serves to ignite the carbon, which burns with great brightness. The violet color of the flame is due to the potassium chlorat.

These are but a few simple experiments dealing with this wide and almost inexhaustible field of experimentation. For when organic chemistry is properly studied, it is not hard to imagine imitation ivory being made of formaldehyde and cheese, to realize that the phonograph record material may be made out of the interaction of formaldehyde and carbolic acid, that exquisite dyes and perfumes are obtained out of a pot of tar, and that the worst of poisons and the best of medicines are based upon a lump of coal. All these interesting things are possible with Organic Chemistry, which, I think you will agree with me is a very interesting and entertaining branch of science.

POWDER USED AS FERTILIZER.

The Scriptural reference to the beating of swords into plowshares has been matched by the inventive German, who started turning the leftover supplies of army powder into commercial fertilizer which the German acres so sorely need. Most military powders have a nitrate base, and as nitrate is one of the three great fertilizing elements German manufacturers of fertilizer bought up great quantities of captured ammunition and the unused powder reserves of the German army to mix with ammonal, another fertilizing ingredient, into a valuable chemical fertilizer.

A watchful government has forbidden the procedure, however, after one lot of the new fertilizer exploded in the mixing machines, owing to the chemical deterioration of the ammonal, and unless some safe way can be devised of using the explosive fertilizer both to break up the soil and to enrich it the new industry is dead.

Similar experience awaited the manufacturers and users of a chemical washing powder put on the market during the war to take the place of the missing soaps and soapy washing powders for laundry purposes.

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Hair Removers

By JOSEPH H. KRAUS

(*Continued from page 415*)

the stick and it is then gently prest upon the hairy surface and when cooled is jerked away bringing the hairs with it. Ouch! you might suddenly exclaim, but it is not nearly as bad as all that, provided that the operation is done rapidly enough, besides the fair sex is willing to undergo any sort of mediaeval tortures in the quest of beauty.

The writer visited a famous New York hair removing parlor, with reference to some information regarding a well advertised depilatory. The demonstration was remarkably effective in that the writer's hand still bears a white band where the operation had taken place. The preparation seems to be a waxy or resinous mass which is heated to a melting point by an ordinary flame, or a small electric stove. When the compound is of the consistency of molasses it is ready for use and the skin is first dusted over slightly with powder and the depilatory is applied.

When the compound had cooled sufficiently so that it was quite hard but not brittle, the attendant lifted one corner of the mass and securing a firm hold, the mass was suddenly pulled off. *Zip* went the compound and the hair came off with it. We did not stop to count them but suffice is to say that it left the skin remarkably clear and smooth. An antiseptic wash and a little cream completed the operation and the writer went away none the worse but the wiser. No special skill is required for the application of this preparation and it is only necessary to pull the mass against the grain, so to speak, of the hair. Under a magnifying glass the roots and their protecting sheath may be clearly seen rising up from the waxlike mass.

We now come to the electrolysis method of removing hair which is a slow and somewhat painful procedure. A needle about the size of a No. 13 cambric needle, is attached to a handle connected to the negative pole of a battery. A moistened sponge electrode is connected to the positive pole. The patient is then seated in a reclining chair, facing a good light, the hair is to be used as the guide for inserting the needle and the instrument is past in alongside of it. After the needle has been inserted to the approximate depth of the follicle the patient is told to grasp the sponge or positive electrode, a slight frothing will be observed a short time later around the mouth of the hair follicle, showing that the electrolytic action has been completed. In order to avoid shock the sponge electrode is first released by the patient and then the needle is withdrawn; the hair should come away with the slightest traction upon it by a pair of depilating forceps. If it does not do this and force is required for its extraction, it is a sign that the follicle has not been properly entered, and, therefore, is not dead. Current is used at a pressure of 12 to 16 volts and one quarter to one and one half milliamperes is allowed to pass thru. If this is not done in the hands of a skilled operator, abscesses or scars are apt to follow and much unnecessary pain may result. In most cases, however, ten to twenty per cent of the hairs remain, or rather so it seems, but as a matter of fact growth of neighboring fine hairs are stimulated by the use of electricity and it is these which grow.

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placed in such a position that the rays will act upon the affected area and she is given a dose of X-rays sufficient to burn the skin to follicular depth. This effectively destroys the hair, but it is accompanied by great danger, stated Dr. William Benham Snow, the eminent electro-therapist, of New York, who does not entertain much favor for the X-ray method, as a serious result is apt to follow. The burns so produced are of course painful, but sometime the skin is beautified immensely, provided that no other serious change in tissue structure occurs. This system is very efficient when properly performed, but it may likewise create considerable trouble and the patient invariably accepts the treatment on her own responsibility.

How Much Horse-Power do You Develop?

By JACQUES BOYER

(*Continued from page* 426)

place his feet, until the proper speed is attained. Fans are installed so as to diminish the errors due to air displacement, and a safety device enables the subject to instantly arrest the motion of the belt. To do this he only has to pull the left hand rail backwards, which disconnects the motor drive. Thanks to this original apparatus Professor Langlois has already completed a certain number of investigations on the human being, as a motor under various conditions of activity. The pedestrian, bicyclist, the litter bearer, and the wheelbarrow man have all been studied. A mask with a spirometer makes it possible to study the respiratory changes, and the experimenter takes the blood pressure during the experiment with a Pachon oscillograph, which is shown on the left-hand table in some of the photographs.

Professor Langlois has already made some very interesting experiments with this moving belt. He first found that this apparatus gave figures identical with those obtained by subjects moving on a fixt pavement. Among other practical results, he was able to observe the "second wind" of oarsmen and runners, that is to say the disappearing of the difficulty in breathing after a rapid start. Hitherto this phenomenon has been assigned different interpretations. With his co-workers, MM. Chailley-Bert and Faillie, Professor Langlois has proved that the second wind is due to a real and sudden diminution of the energy expended, altho the work seemed to remain constant. This is due to a better adaptation of man's motive apparatus, bringing about a definite improvement in its economy.

Home Electrics

G. L. HOADLEY, M. E.

(*Continued from page* 430)

the circuit being broken at switch II by rotating switch IV once.

Knife switches may be used also for controlling lights from several locations. Fig. 8 shows an arrangement of a circuit controlling three locations by the use of two single-pole switches and one double-pole switch. By adding another double pole-switch, four locations for controlling the lights may be obtained, etc.

Fig. 9 shows a typical application of three-way switches, and one double pole, and two single pole switches to stairways of hall circuits. Closing the switch on the first floor lights the lamps on the first and second floors. Operating the switch on the second floor shuts off the first floor light, and puts on the third floor to the top. By using two single-pole switches on the fifth floor, this lamp may be left burning, if desired.

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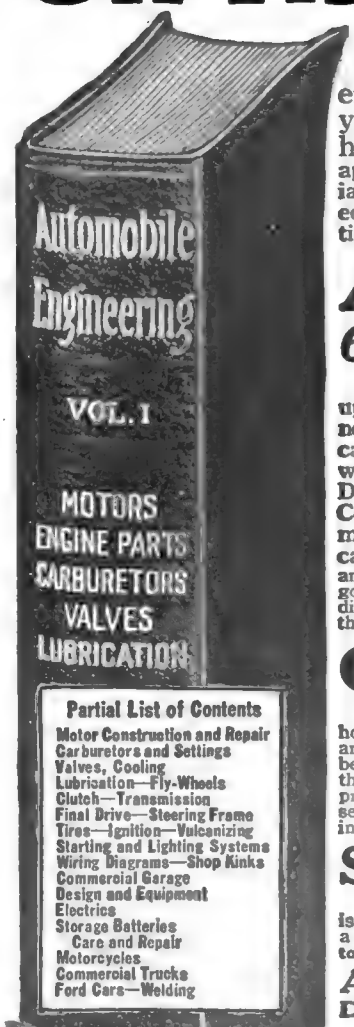

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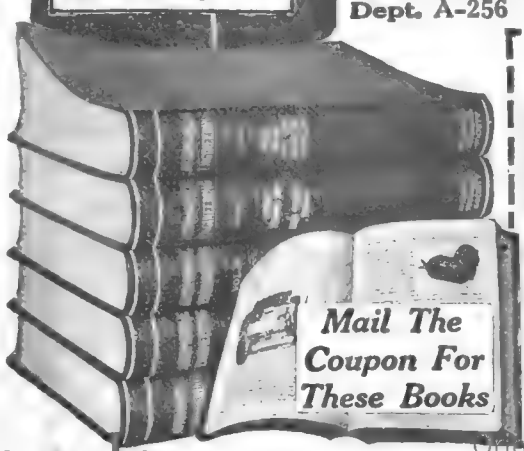

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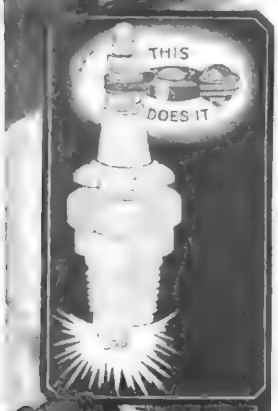

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The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page 431*)

or in volume, but continued to flow from his head, until passing one of the wands over his head the water left the spot and spouted from the wand. Here it started to shoot upward from the very tip as high as before.

Meanwhile the fountain in the center of the room had ceased its mirthful splashing. Hargrave continued to approach me until I told him that I was not quite ready for a shower bath. Then moving the first wand toward the second one in his other hand, the fountain jet was immediately transferred. During the entire process he continued with a rather merry patter, which I could not duplicate, were I even to try. Purposely or accidentally dropping one wand, the stream of water suddenly shifted to his right foot and then placing the left foot over the right, he sort of quenched the tiny fountain, which then transferred itself automatically to the left foot. Then, as tho he were touching off a series of fireworks, the water sprouted from his head, both wands and both feet. At his command the streams all ceased with the exception of one, which continued to sprout from the wand held in his right hand, and then with the words, "To show you that there is no trick attached to this feat, I will let you have the wand, but be careful and direct the stream away from you, as otherwise you will get a shower which you do not desire." He then added, "Should I now tell the jet from the wand to stop, it will do so." My response was immediate, "I don't believe it." "Very well, then." Turning around and walking toward the fountain in the center of the room, he commanded the one in my hand to stop. It did so almost immediately, while the sculptural bowl in the center of the room again started to play and sparkle.

So pretty was the effect and so strange and uncanny were the results, that I even failed to ask him how it was done. He grinned at my expression of astonishment, then added, "Come, come, old timer, you don't mean to tell me you don't know the trick?" I had to admit that I was "green." He then continued as was his usual wont, to explain in detail the entire contrivance. "You see it is very simple. Suspended from a shoulder strap is this tank." Here he removed it. "The tank is made of brass 3½" in diameter and a little more than 10" long. To the bottom end is soldered—" Here I interrupted him with the exclamation, "now I see how it is done." "Well, well, the boy is coming to his senses," was his reply, "but to continue. To the bottom of the tank is soldered a piece of ordinary brass tubing, large enough to receive a rubber hose of about ¼" diameter. This rubber hose connects at the waist line to a five-branched valve, the openings of which in turn connect to openings of considerably smaller diameter, as I have illustrated here. The distal extremities of the valve or the outlets then communicate with rubber tubing, the hole of which is ⅛" in diameter. These tiny rubber tubes then connect to pointed nozzles located in the toes of both shoes and in the turban. On either hand a different type nozzle is fixt which takes the shape of an ordinary piece of brass tubing tapered slightly. This brass tubing connects with a hole in the wand thru which the water flows."

Here I interrupted him the second time. "I didn't see any hole in the end of the wand." "I know you didn't, foolish," was his retort. "Do you suppose for one moment that I would have handed it to you if I thought you were going to see anything? You saw nothing but the hole from which

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the stream of water flowed." I reached for the wand in order to give it a more thoro inspection, but he got there before I did, and the result was that I had to await his explanation. "You see one of those wands is not prepared at all. The water enters at the handle and makes its exit at the other end. The other wand *is* prepared. With regard to the tank again, I filled this tank about three-quarters full of water and then pumped about sixty pounds of air into the remaining space. Of course the tank must be thoroly tested first. This air pressure gives me sufficient energy to force the streams of water to a considerable height and the location of the streams is automatically controlled by the valve strapt to the belt. The valve is simple in construction, the details of which I can give you in a diagram more readily than in words. You will note that pressure upon the button either turns the stream of water on or off, but the pressure does not necessarily have to be maintained as the valve locks in either position. When I started the exhibit, you perhaps noticed that the fountain in the center of the room died down. The reason for that was the fact that a duplicate switch may be found at the base if you examine the floor closely. This switch turns off the electric motor operating the pump for the fountain. My first device constructed along this idea was an ordinary hot water bag, which was likewise strapt in such a position, that pressure with the arm upon the bag would force the water thru the bags or tubes. This device was not as efficient as the one I am applying at the present time, and prevented freedom of motion to a very great extent, even tho the uninitiated would never notice this lack of freedom. With the hot water bag appliance, I simply added a stopper coupled to which was a small piece of tubing, but altho this idea may do for the amateur entertainer, it is advisable to use the better form of apparatus; that is all there is to the stunt."

I had taken the drawings he had made and already started to depart when I remembered that he had not described the wand and I called his attention to the fact. "Oh, that is the simplest of all," he continued. "It consists of an ordinary hollow wand fitted at both ends with a cap, the springs holding the caps in place similar to the coin wand, which I described some time ago. At one end there is an opening into which the tapered brass connection in the performer's right hand fits. This brass tube is 3″ long, the wand itself being 12″ long and made of brass tubing. Here," and he illustrated it with a diagram, "is a washer about ½″ long and fitted with a rubber end. The washer has a hole drilled thru it just a little larger than the tube over which it slides. A valve such as is used in some toy balloons closes this opening when this trigger is released. The spring inside will then cause the water to continue to flow, even when the wand is not connected with the water reservoir." "You commanded the wand to stop flowing, how did you do that?" "It is a simple matter, old top, to time the length of flow from the moment the wand leaves my hand until it stops, and it is only necessary for me to parry for that time, when I know that the wand will cease its flow, with remarkable accuracy at the predetermined instant." Changing the conversation for a few moments to other subjects, I departed, thanking him heartily.

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Building Home-Made Transformers

By H. H. PARKER

(*Continued from page* 436)

age" transformer and while not as efficient as the usual form, there is much less disturbance of the primary circuit in case of a partial or full secondary "short," or when heavy secondary currents are purposely drawn.

In radio work the magnetic leakage construction is sometimes carried to the extent of providing an extra laminated iron tongue between the two windings. Instead of superimposing the two windings, these are frequently made in the form of narrow "pancake" coils and are then strung on the core, primary and secondary pancake coils alternating, the sets being connected in series or parallel as desired. This construction is for the purpose of lowering the reactance of the transformer and so increasing its efficiency. Another type, not often found in amateur construction is the "shell type," where the core has three legs with the windings upon the center one, the core surrounding the coils.

For experimental work the two primary coils are sometimes connected to a D. P. D. T. switch, so connected, that throwing the blades one way will put the coils in series, while the opposite throw will connect them in parallel, thus using half the number of primary turns, doubling the primary current and the secondary voltage. If the windings are designed for normal series connection, placing them in parallel for any length of time will cause heating but the arrangement is perfectly satisfactory for experimental work. Or the series connection could be used for a 220 primary voltage and the parallel coils on 110, with equal efficiency.

If form wound coils are not used, a neat construction is to wind the coils direct on the core, using fiber end flanges with one edge extended for the terminal binding posts; no connection panel is then necessary. The windings are wrapt with a layer of hard cord and several coats of shellac applied; this is a compact arrangement and one not easily damaged.

Some are not aware that, leaving the secondary windings entirely out of consideration, the two primary coils may be connected up to form an "auto-transformer," where the secondary current is tapt off the same coil that is connected to the mains. The two coils are in series with an intermediate terminal taken from the connection between them. Attaching the 110 volt mains between either outside terminal and the middle one, 220 volts may be drawn from the outer terminals; or these may be connected to 220 volt mains and 110 drawn from either coil. If 110 volts is put across the outer terminals, 55 may be taken from the middle and either outside terminal. Another arrangement might be termed a "stepless" or 1 to 1 ratio transformer; one primary coil is attached to the 110 volt mains and 110 drawn from the other; the advantage of this is that, for experimental work, the 110 volt "secondary" wires may be shorted at will without blowing the house fuses—something that obviously cannot be accomplished without the transformer in the circuit.

In conclusion, as a word of warning let it be said that the transformer builder must always take care that he does not accidentally attach a low voltage secondary winding to the mains, as this would induce a high voltage in the regular primary coil, and a dangerous shock might result before the house fuses blew.

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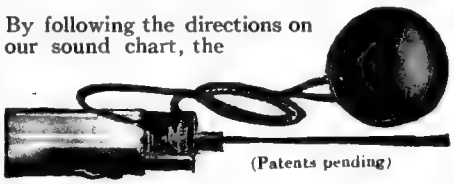

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The Transformation of Professor Schmitz

By GEORGE R. WELLS

(*Continued from page 414*)

he, but this fellow resembles the picture of Steinmetz. I thought you had seen his picture. Of course you have not met him personally, here in Kansas."

"You are right" I answered. "I remember now. I have seen the picture of Steinmetz, several times. This man does resemble him. He is short, he has broad shoulders and almost no neck at all. He is almost bald too. I wonder if his face also looks like Steinmetz. I wish he would turn around so that we might see."

One thing was apparent, however. The man, whoever he was, was giving closer attention to the speaker than we were. He did not look around either.

When it came our turn to entertain, Leo adjusted the loud talker, and gave a brief explanation of the working principles of the telephone, while I took my post at the transmitter in another room. Soon after the exhibition was over, the people left. By the time I got back to Leo, there was a crowd about him, congratulating him on the success of his machine. As our singular friend had also gone, we ventured to ask who the old gentleman was. No one seemed to know much about him. His name was Schmitz, and he lived in a tiny house at the foot of Bleumont. Bleumont is a high hill, that rises almost vertically a hundred feet, at the north side of town. This is all we could learn of him.

The last scientist had gone. We had taken down our wireless and were putting it away, when I heard some one enter the room. I looked up and saw the stranger. "Good evening, boys." He offered his hand to Leo and then to me. "My name is Schmitz."

"My name is Leo Swanson."

"Mine is Dick Harvey."

"I enjoyed the program immensely, and especially the wireless part," continued Mr. Schmitz. "When I was your age I also was an enthusiastic amateur experimenter, nor am I less enthusiastic now but perhaps I am no longer an amateur. As I was leaving the building, I thought of my college days, when I was working, studying and experimenting, much the same as you seem to be doing. I felt certain that you would be pleased to know some of the things that I am doing now. I came back to ask you to go with me to see my research laboratory. I have a large laboratory all of my own. It is the pride of my life. Wouldn't you like to come with me to-night to see it?"

"Would we? Nothing could suit better." And then "Hooray" I shouted "tomorrow is Sunday and we have no classes. We may stay all night if you will let us."

"You are too conscientious," objected Leo. "Lessons or no lessons you could not tie me away from a treat like this. A fellow cannot let his studies cheat him out of a real education."

Ah! How little we guessed what an education we were to experience before the morning. As we walked along an unpaved street, in the darkness, Professor Schmitz told us the story of his life. He told how, like ourselves, he had come to college to master the art of his hobby. He had worked his way and studied hard. After graduation he had accepted a position as head of the Department of Physics, at Kansas State College. Here he worked for many years, teaching in the day time, and grading papers and experimenting late into the night. During these years of professorship he perfected an idea that he

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was working on before he entered college. This was an improved type of electrical transformer. "Ah those were the happiest days that I had ever known. I patented my invention and offered it to one of the largest electrical corporations in America. The transformer was so efficient that the corporation adopted it in preference to all other makes. Now I live on the royalty of the patent and spend all my time in my laboratory. I never have to give a thought to finances. The royalty more than pays every expense. Here is my home and laboratory" he said, as he stopt before the door of a tiny house, close against the high black hill.

I nudged Leo. "How on earth can a kennel the size of this contain a laboratory such as he has been telling us of?" Leo was silent.

The professor opened the door and snapt a switch. We stept into a very small room lighted by a single electric bulb. A small table with a chair before it, stood beneath the only west window. Electric cooking utensils and the remains of a light supper, were on the table. In the southwest corner of the room, to our left as we entered the door, was the cupboard. On the other side of the door was a combination bookcase and writing desk, containing an encyclopedia and some two hundred other books. A chair was also drawn up before the bookcase. In the northeast corner of the room stood a small cot. There was nothing else of importance in the room. The north wall was bare except for a large mirror and a couple of fine colored landscape photographs.

Leo looked at me with an expression of pain in his eyes. Words were unnecessary. I knew that he thought the same as I, that the old man was insane. There was nothing suggestive of a laboratory. We were startled by a chuckle. The old man was laughing.

"I know what you are thinking," he said, "this is my home as the people of this town see it, but I shall disclose to you my secret." As he spoke he prest a button. "I got this idea from the movies. It works to perfection." The entire back wall of the room sank steadily into a slot in the floor. I saw Leo's jaw drop. I caught my breath sharply between my teeth. Before us lay an immense room. The white of the walls and towering supporting columns, glistened in the diffused light from hundreds of electric bulbs.

"This is my workshop boys. Step in, and do not be so bashful."

We past thru the opening into what seemed a magic fairyland. A pressure of a button, and the odd portal shifted noiselessly into place behind us, shutting us off from the world of realities. One entire wall of this wonderful laboratory was lined with shelves piled high with books of every kind of science. This division was the professor's library.

All of the floor space of the laboratory was covered with electrical and chemical apparatus of all sorts systematically arranged. Some of them were familiar to us while there were others, the use of which we could not imagine. In opposite corners of the room, our attention was drawn to specially elaborate apparatus. Both instruments were exactly alike and very large. They seemed to be a combination of radio, chemical, optical, and physical machines.

"These are my pet instruments," said the professor, as he moved his hand fondly and caressingly over the many knobs and handles. "I have been working on these instruments for two years. My work has been rewarded by the most gratifying results. I have two large aerials on the top

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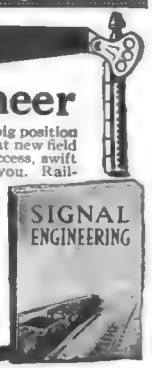

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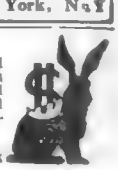

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of the hill above us. They are parallel and about a quarter of a mile apart. The lead-in of one of them is connected to the instrument in that corner; the other is connected to this one. Each aerial is composed of three hundred strands of fine helium wire."

"Helium?" gasped Leo. "I thought that helium was a gas."

"So it is my son, as you know it. I do not suppose any one beside myself has learned how to condense the gaseous helium to the solid state, but it can be done, nevertheless. To be sure it is an expensive process, but it is a very important metal. I expect soon to give the secret to the world.

"As I was about to say, the strands of the antennae are placed about three inches apart. Each strand is made up of two wires, twisted with fine barbs, like barbed-wire used in fences, only, that they are many times smaller, and closer together. Such an antenna possesses, not only the properties of the ordinary antenna, but also those of the newly invented radium accumulator. With these instruments I have received wireless messages from practically every radio station in the world. For a while I thought that I was hearing radio signals from Mars but I discovered that it was the radiant electrical energy of the sun, on my helium antenna, that caused the sound.

"Science will not advance much farther until it combines the science of physics, chemistry and electricity with those of life and mind. Modern science has agreed that all matter is composed of molecules. Molecules are still farther divided into atoms and atoms are made up of electrons. Thus everything, including animals, plants, light, heat, air, and the ether of space, is composed of electrons in different combinations. Psychists have long contended that the human aura can be seen. My experiences have confirmed this statement. The human aura is also made up of electrons and is caused by the mind.

"It was on this theory that I based my work. The whole affair has worked like a top. That is why I could hear the sun shining on my helium antenna. The helium strands are as well adapted to the reception of electrons emitted by the sun as they are to those sent out by some far distant radio station.

"I am now ready to show you my latest discovery. That is what I really wanted you to come here to see. It is based on the principles, that I have been telling you of, and is entirely successful. I actually believe, that, with a little more experimenting, I will be able to communicate electrically with the spirits of the dead. I will show you what I have been doing, then what I have been trying to do. When my present experiment is successful, I will begin on the spirit problem. Just think what it might mean to know the secret of death. We might learn a new way to die, and learn also how to resurrect the dead. But be that as it may, you are anxious to see what I have done. You shall not be disappointed."

The professor closed a large switch and a large motor-generator began to hum. The closing of another switch sent a heavy stream of high frequency sparks crashing between two big silver balls. The professor adjusted several knobs and carefully set the pointer of a condenser. The sparking ceased. Slowly a musical note sounded and increased in volume until it filled the room. Two large globes, similar to X-ray tubes, at either end of a large helix, began to glow. The sound rapidly rose in pitch until it became a whistle. The professor turned a switch and we stood in darkness. When the whistle be-

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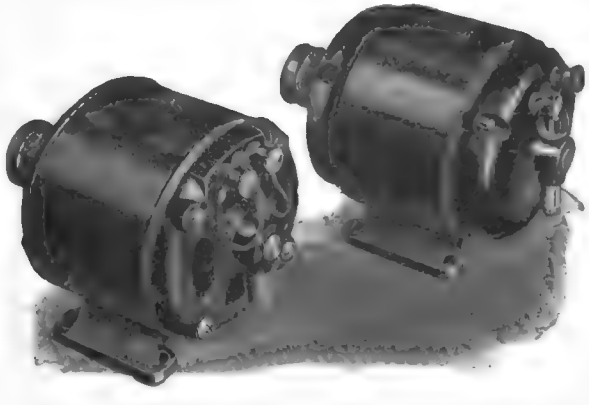

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came inaudible, we knew that the vibrations were too high to be heard by the human ear. A faint light began to play between the glass tubes. It became an intense crimson, then changed to orange, then yellow, green, blue, violet, and then became invisible as the frequency exceeded the highest vibrations of visual light.

The professor turned on the light. "You understand," he said, "that electro-magnetic waves are oscillating between those tubes. These magnetic waves, passing thru the coil, cause a current of the same frequency to move in the windings. A current of this frequency cannot be registered by any of the senses. The terminals of the helix are connected to either side of this cabinet. Come here Tom," he said as he stooped for the big Angora tomcat that sat purring at his feet. "Show the boys how we do it." He put the cat in the cabinet and closed the glass door. The cat mewed loudly. "No cat likes to be shut up in a box," said the professor, "but we won't hurt you, Tom." The professor prest the wireless key. There appeared a dazzling flash of light, in the cabinet, as the cat was transformed into free electrons. The cabinet was empty. Leo looked as if he was having a bad dream. I suppose I appeared even more horrified. A plaintive "Meow" sounded from the opposite corner of the room. The professor walked calmly over to the other instrument and released Tom from the cabinet there.

Leo and I were too dazed and dumfounded to speak. The professor was performing miracles and doing impossible things before our very eyes. Leo looked agitated. I felt nervous.

"You see it was this way," explained the professor. "When I prest the key, the coil charged the cabinet with the high frequency current. The flash marked the instant when the electrons were vibrating at the frequency of light. You understand that normally the electrons of a cat vibrate very slowly. When they are subjected to the high frequency current they rapidly increase in rate of vibration, until their rate is the same as that of the charging current. Of course there is an interval where the oscillations are visible as light. This cabinet is an *electron transformer*. When the cat was transformed, the electrons were transmitted from the antennae of this instrument and received by the antennae of the instrument over there, just as wireless waves are transmitted and received. You see the result. Tom is just as much alive and as well contented as he ever was. In fact he has made the trip, just as he did for you, no less than a hundred times.

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"I should say I will not," wailed Leo in terror.

I almost yelled, I was so shocked at the thought.

"Very well," snapt the professor, a bit disgusted. "To prove to you how absolutely safe it is I will show you a few more experiments."

He placed a collie dog in the cabinet and prest the key The result was a flash of light and then emptiness, just as it was with the cat. Professor Schmitz crost the room to the receiver and released the dog from the cabinet, as he had previously released the cat. Next he placed a book in the cabinet. The book was followed by a canary bird, then a gold watch, a pair of shoes, a silver ring, a neck-tie, a pocket camera, and lastly, a picture

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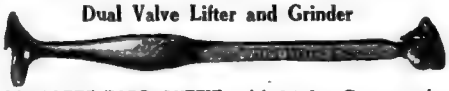

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Each and every article came thru exactly as it had been put into the transmitter. The book was open at the same page. The canary sang without an interruption. The shoes were the same and the watch was still ticking. No time had elapsed from the disappearance of an article from one instrument, until it appeared in the other.

"Don't you feel a bit ashamed to distrust me?" asked the professor.

"I beg your pardon, professor," I apologized. "I am both ashamed and sorry to have disappointed you."

"I am too," said Leo. "But think professor, it is all so new, so unreal and so uncanny, that I can hardly believe it. Nevertheless, I am at your service now. I will do anything you ask me. Shall I get into the cabinet now?"

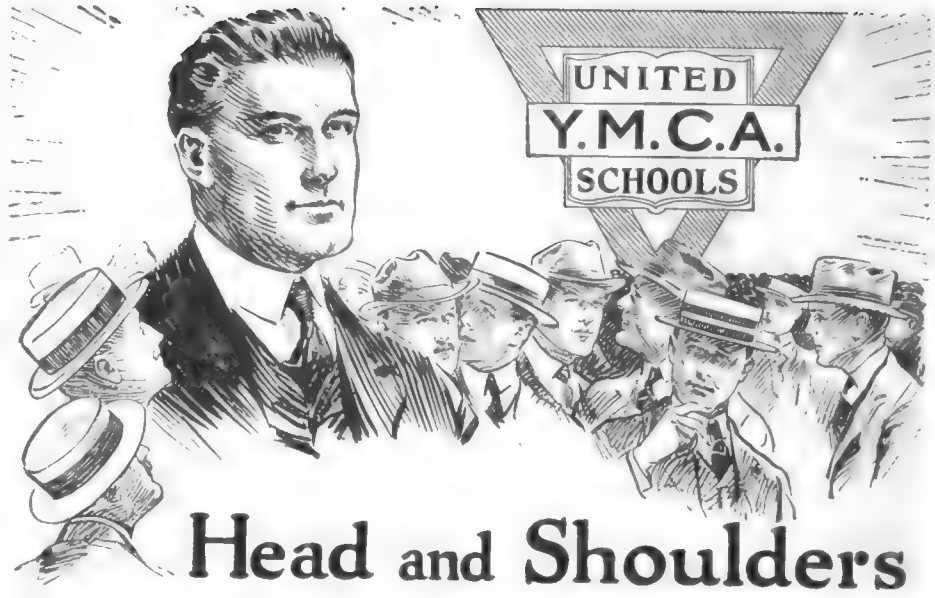
"No," answered the professor. "You are experienced at wireless. You just press the key. I will get in myself. I want to be the first person to go thru, anyway."

Leo became deathly pale. His hand seemed to tremble slightly. He set his jaw firmly. He would not disappoint the professor again by refusing to comply with his wishes. He would either press the key or die trying to do it. The professor stept into the electron transmitter and pulled the door shut after him. With a smile of serene satisfaction, he motioned for Leo to press the key. Leo hesitated an instant, then gritted his teeth and closed the key. The flash that followed, blinded us momentarily. Then we saw that the cabinet was empty. I followed close behind Leo as he hurried to the other instrument. I saw Leo raise his hand to open the receiving cabinet, and then he fell headlong, striking his head on the iron base of a motor. I stood there for a moment, shivering, horrified. This cabinet also was empty. The professor had failed to come in at the receiving station.

The sight of Leo lying there so still, with the blood slowly oozing from his brow, roused me to action. I knelt and rolled him over on his back. He was not dead. He was still breathing. He had only fainted. The realization of the professor's fate was too much for the boy's strained nerves. For a moment I dashed madly about the laboratory in search of water. Finding a cup at the fountain, I bathed my friend's forehead. He soon regained consciousness. "Oh my head hurts. What has happened?" And then as his senses returned, "if you are my friend, Dick, help me out of here as quickly as you can. What on earth have I done? Where is Professor Schmitz? Have I killed him? Oh what can it all mean?" groaned the miserable lad.

"There old man, don't talk that way. You have killed no one. If he is dead he did it himself. But surely a person cannot die without leaving a body. But Oh—but Oh, what can have happened."

From here on, all is confusion for me. I hardly know, how I pulled the switch that stopt the machinery, or where I found the button that opened the door to the professor's ante-room. It all seems a dreadful dream. Leo leaned heavily on my shoulders, as I helped him unsteadily out into the street. I remember faintly; the back wall of the room rising again to its place; the single light of the little room blinking out at the snap of a switch; the click of the key as I bolted the door; and the painful walk in the darkness to our room. When we reached home it was four o'clock Sunday morning. Leo was nearly sick. We were both utterly exhausted. I helped Leo to bathe his head a bit and he crawled into his bed. I threw myself down on my cot without undressing.



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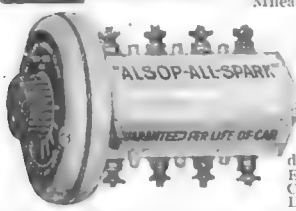

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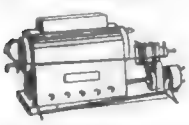

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When I awoke, the beautiful May sunshine filled the room, it was eleven o'clock. My first thought was that I had had a nightmare. A low moan caused me to look toward Leo, his left eye was swollen shut. Above the eye appeared an ugly cut. He said that his head was a hing so that he was quite ill. I bandaged his head with a cold damp towel. After a while he felt better and sat up.

That afternoon, for some unaccountable reason, I wandered back to the mysterious laboratory. The lights were still burning, but somehow the place was strangely quiet and lonely. The dog and the cat had made their escape thru some hidden exit. The canary hopped silently about in his cage. Sometimes he would emit a forlorn chirp. In spite of my harrowing adventure, the laboratory holds a strange attraction for me. I know that I shall go back there every day. If ever I learn the terrible riddle I will tell you about it. Meanwhile, I feel it my duty to look after the place and care for the bereft canary bird.

Einstein's Third Prediction Verified

French scientists have announced that they have verified Einstein's third prediction, that the wave length of light from the sun is slightly longer than similar light produced on earth.

Monsieur A. Perot, in a recent number of *Comptes Rendus*, the official journal of the French Academy of Sciences, declares that his researches show that the wave length of the magnesium lines of the sun are longer by about two parts in a million than the same kind of light produced here on earth. This, he points out, is exactly the difference that the Einstein theory requires.

Einstein's theory first scored one over Newton's when it accounted for the shift of 42 seconds of arc that the planet Mercury takes each century over and above that allowed by the Newtonian law. This discrepancy had puzzled astronomers for two centuries.

When it was announced that the British astronomers who went to Africa to observe the eclipse of the sun on May 29, 1919, had found that a ray of light passing close by the sun bent out of its straight course, this was the second confirmation of Einstein's theory, and that announcement set the general public talking about the Einstein theory.

The verification that has just been announced is the last of the three practical predictions that Einstein has suggested as checkable by observation. General acceptance of M. Perot's findings and further proof of the deviation of the light rays in a gravitational field (as reported by the British eclipse experiment) would practically amount to a proof of the Einstein theory.

The Fraunhofer lines, used in wave length measurement, can be seen as dark lines on the solar spectrum background and have their origin in the "reversing layer" of the sun. It has been believed that the pressure varies at different parts of this "reversing layer" and that this change in pressure caused the difference in wave length between the solar light and the earthly light of the same kind. But M. Perot by his interferometer measurements has come to the conclusion that the magnesium vapor of the sun is practically at zero pressure and not as supposed, under high pressure, and that the Einstein theory is needed to explain the difference in wave length between solar magnesium light and the kind of magnesium light that is produced here.

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Squeeze your hand down on an ordinary stamp pad until the entire hand is lightly covered with ink (or, you can use printer's ink, or stove blackening). Press your hand down evenly on a clean sheet of paper. Then, with a pencil, trace the outline of your fingers. The result will be a clear hand print. Do the same with the other hand on a separate sheet of paper.

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PATENT ADVICE

Edited by H. Gernsback

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Commutatorless D. C. Dynamo

(476) W. E. Paul, Portland, Ore., asks us a few questions and then requests patent advice on a commutatorless D. C. generator which he claims he built; address of concern is asked for.

A. The finest high tension D. C. system known of today, is one which at first develops a very high potential A. C. This potential is subsequently rectified to D. C. thru gigantic Tungar rectifier tubes.

There are other D. C. generators which have recently been placed on the market, but such generators are now subject to infringment proceedings, and therefore, we cannot furnish the address until this matter has been cleared in the federal courts.

Your idea is certainly wonderful, if it works. We have received thousands of D. C. commutatorless machine designs, and very few of them are workable even in theory, which is saying a great deal.

Electric Furnace Carbons

(477) Earl Seidel, Los Angeles, Calif., desires patent advice on carbon electrodes for electrical furnaces, which are shaped so as to present a large number of sparking points along their edges.

A. We do not believe the idea which you have advanced, to be very practical because as you know, carbons are always consumed when a current is applied and for that reason your carbons will not hold their shape very long, necessitating constant removal and replacement.

Furthermore, you have made no allowance for adjustments. The cost of carbons for your outfit will be rather high; at least 100 or 200 per cent higher than that of simple cylindrical or prismatic electrodes, equal weight of carbon grains, which are used in many heaters.

Patents and Caveats

(478) B. E. Pavey, Chicago, Ill., asks: What recent patents or caveats are there on perpetual motion machines?

A. There have been no patents issued covering perpetual motion machines, as such, in recent years. The Patent Office requires a model with such applications and none has been forthcoming—or ever will.

Caveats are no longer allowed by the U. S. Patent Office and hence there are, of course, none covering perpetual motion machines. We have up to the present time never seen a machine whose working ability or powers could not be upset by common mathematical calculations or ordinary reasoning.

Sulfur Dioxid Engine

(479) Chas. L. Barkley, Winston, Salem, N. C., asks whether he can obtain a patent on a sulfur dioxid engine.

A. There is nothing new in this system and in fact, it is far inferior to the one employed by several stations in California.

You must admit that it requires energy to change sulfur dioxid to the liquid state and likewise to evaporate it, which we believe you intend to do with your machine. Hence there are losses both here and in the turbo-generator. Why waste time in doing this, when far less energy is required for steam turbines developing the same horse-power?

If you intend using sun rays or sun power to carry on the evaporation of the gas from the liquid state, we would advise you to try to improve the system described.

Attachment for Telephone Transmitters

(480) Forrest Royder, Wellborn, Texas, asks our opinion of a simple metal disc attachment for telephone transmitters, claiming improved speech transmission.

A. It is quite possible to obtain a patent on the device which you have suggested, but we doubt its relative value and its acceptance by the Telephone Companies.

If you were to take a look at the Telephone Companies' museum and see the thousands of devices which have been invented to improve telephone service, and which have failed by the very extensive tests which the companies applied to each and every device submitted, you would not attempt to make an adjustment to improve the present service, unless the same were of exceptional merit, which we doubt yours to be.

Rolling Baggage Trunk

(481) A. M. Robertson, Keremeos, B. C., Canada, submits an idea of a rolling baggage trunk and requests our opinion.

A. We believe that the particular design of the trunk you have illustrated is indeed very clever, and we would advise you to get in touch with a competent patent attorney with a view to securing a patent.

With regard to the financing of such a device, we would state that this rests entirely with yourself and you can try to interest clients after you have made a patentability search or have otherwise protected your idea by priority claims.

Renewable Lamp Filament

(482) A. J. Reek, Cleveland, Ohio, places a filament in a curved glass tube, which is attached to a base claiming a renewable incandescent lamp filament.

A. We fail to see anything in your idea, regarding filaments inserted in curved vacuum tubes for use in incandescent lights for the reason that it is far easier to manufacture a lamp complete than to attempt inserting the filaments in such small glass tubes and then exhaust them.

Further than that, it is more difficult to produce the desired vacuum in a small tube than it is in a larger tube and if the tube is gas-filled and the filament should sag even slightly, it would immediately strike the glass, probably causing damage in that manner.

In view of the fact that it will be just as expensive, just as difficult to manufacture, and even more so, and far more inconvenient to manufacture and handle the electric lamps you have designed, we would not advise a patent upon such an idea.

Film Take-Up

(483) Clyde Stewart, Westboro, Wisconsin, submits an idea of a film take-up, operated by a motor whose speed is regulated by a rheostat controlled by the sag of a picture film.

A. In your description of the device you state that the operator turns the crank of the projector and that a motor whose speed is variable thru the agency of a very ingenious control operates the take-up reel.

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There are two features about such an arrangement which would disqualify it. In the first place the speed of a motor cannot be varied as rapidly as you have indicated so that the take-up reel will operate evenly. For instance when the operator is turning the crank so that one foot of film passes between the rollers per second, it is obvious that in order to regulate the take-up reel, a very speedy adjustment must take place which cannot be done by a rheostat.

Secondly, your system necessitates the use of both manual power and electrical power for proper operation, or if electric power is used in both instances, you must employ an additional motor to operate your film take-up reel. In the modern machines only one motor does all this work, and the spring belt now employed, together with the friction clutch used for operating the take-up reel allows for sufficient slippage to prevent tearing of the film.

In view of the additional expense of an extra motor, an additional control, extra use of power, and the additional repair of this motor with but a slight gain in better operation, we hesitate at advising patent.

Anti-Glare Device

(484) Andrew M. Stiles, Auburn, N. Y., sends us an idea of an anti-glare attachment for automobiles.

A. We do not advise a patent upon your anti-glare attachment for automobiles because there are too many of these on the market at the present day, very few of which have met with any success.

If you could, however, interest a concern sufficiently so that they will guarantee to commercialize this device, it would be well to proceed to obtain a patent. If not, we would not advise you to spend any more time upon such a system. Today, colored spectacles serve the same function and they can not only be used to protect the wearer's eyes from dust and particles of dirt, but can be used to enlarge or decrease the size of the images, and also could be used in open body cars and coupes, even if the top of the car, or the windshield, is missing, where your device, of course, would be impractical.

Balloon Fabric

(485) John E. Sebesi, Prichberg, Pa., submits a sample of a balloon fabric composed of several layers of paper and canvas, and requests our advice.

A. We do not believe that the balloon fabric constructed as you have devised, will be of any value whatsoever, for the simple reason that the papers between the layers of duck do not allow for sufficient flexibility.

Impregnating duck with a rubberized solution is without a doubt much cheaper, and furnishes a more lasting product that the paper duck composition.

Wave Motor

(486) W. Southern, Chelsea, Mass., submits a drawing of a wave motor in which a float has two buoyant arms attached to it, which, due to wave motion, operates two pumps. The water is then conveyed to the turbines.

A. In our opinion the wave motor which you have devised is quite clever, but we do not believe that it would warrant a patent, because there are hundreds of devices more ingenious and very similar, which will probably never be put to practical use.

A wave motor should be designed which will utilize every conceivable motion of the waters, whether upwards, sidewise, or laterally, which will buffet winds, which does not need expensive piers, and which could be made cheaply and develop considerable power without requiring constant attention. Your device does not utilize every wave motion and much of the energy is lost.

Railroad Signal

(487) Samuel Terry, Butler, Pa., submits a sketch of a swinging red light signal for railroad crossings.

A. Although your idea of a red light signal for railroad crossings is feasible and perhaps patentable, we do not believe that it will be of material value.

The editor has seen automobiles go tearing down the road and in spite of every type of visual signal available and altho the railroad gates were down, and then played on with powerful searchlights with a red light also suspended from the gate, the automobile dashed thru it, breaking the gate and proceeded up a slope on the opposite side.

For some automobiles, it is necessary that a signal be employed which will be irresistible to the onslaught of a fanatic motorist. Perhaps a series of powerful searchlights thrown in such a manner as to blind the oncoming motorist would prevent some of them from crossing the railroad track at breakneck speed.

Again we reiterate that we do not believe that a railroad company will look favorably upon your device and the patent, unless a financial success, is worthless.

The latest *Patent Gazette* contains a record of a patent exactly similar to your device.

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Inside of a Piece of Sugar

(*Continued from page* 411)

men, inspecting the works of a watch, bringing out the fact that this wonderful mechanism, if seen by men but n eighth or a sixteenth of an inch in height, would be a stupendous spectacle. ut now let us imagine our men still smaller, down below the ultra-microscopic size. Imagine them surrounded by a mass of molecules, say of sugar. In each molecule there are upwards of a 100 electrons, some bound by the carbon nucleus, others by the hydrogen nucleus, and others by the oxygen nucleus. Six atoms of carbon, twelve of hydrogen and six of oxygen are bound up into each molecule, and each molecule is seething with the energy of its twenty-four constituent atoms. Our ultra-microscopic men are spectators of an amazing ocean of energy. We can imagine the electrons whirling in their ultra-microscopic orbits, with reciprocating movements perhaps, as they repel each other's advances, and presenting a world of energy, which to our little men could be nothing less than terrifying.

One thing only will save these spectators from annihilation; it is that the energy of the atom is rigidly held within its own confines, and, that no way has yet been discovered, of setting it free for either beneficent or destructive purposes.

The spectators of the watch movement, confrères of our inhabitants of the ultra-microscopic world, to them were enormous giants, yet the astonishment of the watch movement with its ceaseless motion and display of enormous force, would be nothing to the wild vortices of energy that the world of sugar would present to the new audience, whom we have here called into being.

So when you next sweeten your tea or coffee, supposing that you take sugar in those beverages, imagine, that with every spoonful you put in, you are carelessly handling an unmeasured quantity of energy, tightly locked up in the molecular and atomic structure of the innocent looking saccharine substance.

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A special apparatus has been designed for fire brigades, enabling a superintendent to be in constant touch with his masked men, and to converse with them readily. Hose men working on ladders and roof tops can keep in telephone touch with those working in other parts of a burning building.

The invention can also be used between chauffeur and motor car passenger, between air pilot and passenger, in noisy workshops, in railway tunnels and in marine engine rooms. The submarine worker can talk to the man at the surface or to another diver below. He can also make signals to the operator by simply dropping his jaw to the full extent, this movement working a switch.

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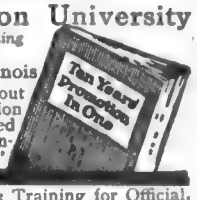

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At a Lecture by Einstein

(*Continued from page* 410)

different times. The sameness of the spot was only relative to the room in which we were placed. And if we wanted the spot to remain the same in an absolute sense, we should have to annihilate the sense of time—that is, the two knocks would have to take place simultaneously."

This is perfectly clear; is this Einstein the Incomprehensible. He continues:—

"You therefore see that identity of place is only possible when the sense of time is absolutely annihilated, and that place is only relative to time. But the converse is equally true; that is to say, there is no time-sameness except when the factor of space ceases to exist."

An exhilarating illusion of clarity comes over us. We understand the Professor even before he explains. He continues:—

"The simultaneity of two events is purely relative. For instance, supposing that at two points equidistant from you two flashes of light were to become simultaneously visible. You would be inclined to say that since light travels with a uniform speed, and the two points were equidistant from you, the outbreaks of light occurred simultaneously. But were you and were the two points of light stationary at the moment of the outbreaks of light, until the moment of the arrival of the light at your eyes? Of course not, for the very earth is not stationary. And your motion with the earth necessarily affected the relativity of the speed of the light to yourself. You were going towards one light and away from the other, and therefore one light came faster towards you and the other more slowly. Hence what you saw simultaneously did not occur simultaneously."

We become almost delirious with joy of perfect understanding. The Professor continues:—

"If, on the other hand, the bodies which emitted the light, and yourself, remained relatively unchanged in position during the experiment, that is, none of you moved relatively to the others, would you still be justified in saying that the outbreaks of light occurred simultaneously? I mean, for instance, if the lights were fixed on the earth, and therefore moved through space with you. No, not even then. For all three bodies are then moving through space. You are aware that light moves with a certain fixed velocity. What is that velocity relative to? To the ether. Light radiates from a luminous point with equal velocity in all directions, but with equal velocity not away from the luminous point, for that itself may be in motion, but with equal velocity in relation to a fixed point in the ether. If, therefore, the luminous body is itself moving through space, the light which is traveling in the same direction as the luminous point itself is only leaving that luminous point at a velocity equal to the velocity of light minus the velocity of the luminous point.

"We have taken the hypothesis that the observer is stationary relative to the luminous points in our experiment. He is therefore moving in the same direction as they. Now we have seen that the light traveling from a moving luminous point in the same direction as the point, moves away from that point more slowly than the light traveling away in the opposite direction. It will, therefore, take that light longer to reach the observer if he is in front of the moving point of light than if he is behind.

"I will make myself clearer. Supposing there is a luminous point in space which is traveling with the same absolute velocity as light. It is clear that those rays of light which travel in the same direction as the

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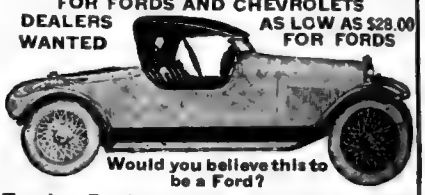

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luminous point will never leave the luminous point, for the luminous point will always be catching up with them. Suppose an observer to be in front of the luminous point of light, and suppose he is stationary relative to the point of light; that is, he is moving in the same direction with the same velocity. Then, as the rays of light never leave the luminous point in that direction, they will never reach the observer. If, however, the common velocity of the luminous point and of the observer diminishes, the light will steadily leave the luminous point and reach the observer. Conversely, if the observer is behind the luminous point, and traveling in the same direction, the ray of light would reach him with twice the velocity of light.

"We therefore see that under any circumstances, when two rays of light strike the observer simultaneously, it is impossible to say that they set out simultaneously.

"It is therefore impossible to establish a simultaneity of events. And similarly, and in consequence, it is impossible to establish a measure of time. A clock moving through space in the same direction as the observer gives a different measure of time according to the relation of the line joining the clock and the observer to the line of light from the clock to the observer, and of the velocity of their common motion to the absolute velocity of light. . . ."

We went from the lecture hall as in a dream. . . In the vast cloak-rooms, where after concerts there is bedlam and pandemonium when the audience comes for its overcoats, there was silence. In silence and dazed thoughtfulness the crowds waited for their clothes. And we went forth into the lightless streets of Vienna like ghosts. For the earth was not under our feet, and the sense of time and space had been taken from us; and like impossible and intangible abstractions we remained immovable and unchangeable in a void which had not even magnitude or duration . . . till the street car came out of the *néant* and without conviction we offered the conductor three kronen.

OUTPUT OF HELIUM QUICKLY STIMULATED.

Helium, which up to April, 1918, was a laboratory curiosity, not more than a hundred cubic feet having been prepared, and that at a cost of about $1,700 to $2,000 a cubic foot, increased in output in that year to a point where it was being produced in Texas alone at the rate of 8,000 cubic feet a day. There is now nearing completion at Fort Worth a $1,700,000 plant.

While the experiments by the Government came too late to be of value in the war, it was developed that natural gases in Canada, Ohio, Oklahoma, Kansas and Texas contain 1 per cent, and sometimes more, of helium, and several processes were worked out similar to those for obtaining liquid air. It is estimated that the Fort Worth plant will be able to produce helium for $5.22 per cu. ft.

The commercial production of helium has been stimulated by the need of a substitute for hydrogen, which is so highly inflammable that its value for military purposes in dirigibles and kite balloons is gravely impaired. Altho the substitution of helium for this purpose entails a loss of 7 per cent in lifting power, this is more than compensated for by the elimination of all risk of fire and explosion. Helium suffers less loss by diffusion than hydrogen and cannot be made to burn or explode.

The relative cheapness of hydrogen still puts a limitation on the use of helium for airships.

The Secretary of the Navy's request recently to Congress to prohibit the exportation of helium indicates that the foreign demand for this rare gas is insistent.

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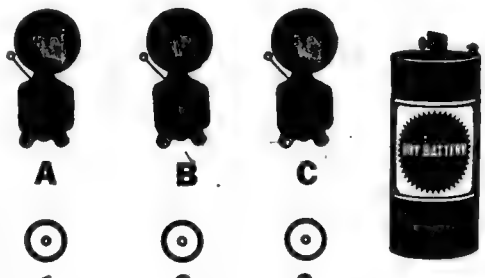

Button No. 1 should ring bell A. Button No. 2 should ring bells B and C in multiple. Button No. 3 should ring bells A, B, and C in multiple. Conditions: Only standard types of push buttons permitted. No wire should cross another. Make sketch on white paper and show inside connections of buttons.

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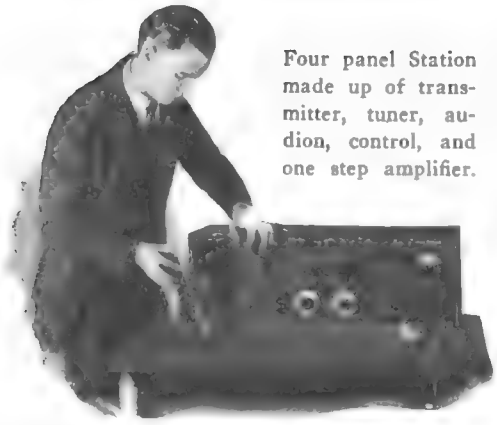

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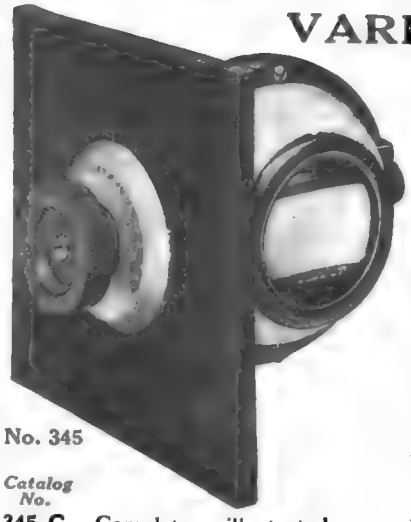

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Resonance Wave Coil Antennae

By J. O. MAUBORGNE and GUY HILL

(*Continued from page* 444)

airplane antenna wire, spaced ¼ inch between turns, and having a fundamental wave length value of about 350 meters, is mounted vertically, in this case a little more than a foot above the transmitting and receiving apparatus, which is grounded to the chassis. The set shown consisted of both transmitting and receiving elements, which could be alternately connected to the same wave coil antenna by means of a throw-over switch, tuning of both the receiver and transmitter being accomplished in the usual manner. With a coil of this kind raised twenty feet about the ground, and connected to a radio telephone transmitter, putting 1.9 amperes into the wave coil antenna, conversation was easily carried on with an amateur having a detector and two stages of audio amplification, distant 60 miles; while an amateur 500 miles distant, provided with a detector and 3 stages of audio-amplification, reported hearing the radio-telephone transmission.

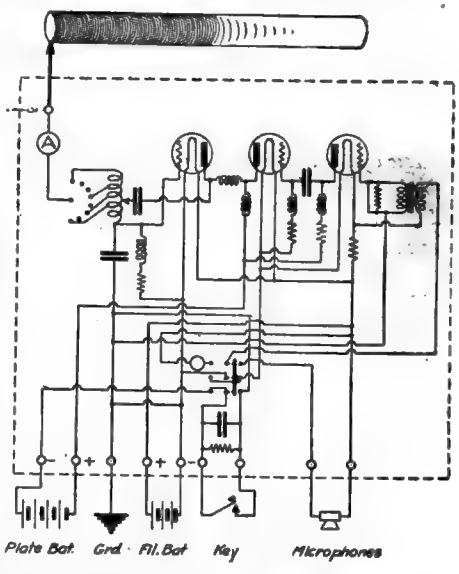

Fig. 6.—While as in the Case Where the Resonance Wave Coil Is Used as a Receiver, it Is to be Noted That it Is Not Necessary to Have Any Antenna or Ground Connection on the Coil, or on the Generator of Continuous Oscillations, as When Employing the Wave Coil in Connection With an Undampt Wave Telephone or Telegraph System. Nevertheless, it Has Been Found in Practice That Far Better Radiation Is Obtained, When the Transmitter Is Grounded and the Apparatus Arranged as Shown in the Diagram Herewith. The Same as Is the Case With the Receiving Apparatus, When the Ground Is Connected to the Transmitter, it Is Necessary That the Antenna System as a Whole, Including the Wave Coil, the Lead Connecting the Wave Coil to the Transmitter, the Secondary Tuning Elements Within the Transmitter, and the Ground Connection Shall All be Tuned to the Same Frequency or Wave Length, as That Determined by the Primary Tuning Arrangements of the Transmitter Itself.

For higher power sets, the obvious method of using the wave coil antenna would be to construct a coil of large size, or to mount a sufficient number of smaller coils in parallel at a suitable height above the ground, and to excite them all from the same source. The coils would naturally be of large proportions for long wave lengths, altho the amount of ground necessary for the installation of such an antenna would be extremely small, when compared with that needed for the installation of the ordinary antenna system for a high-power set.

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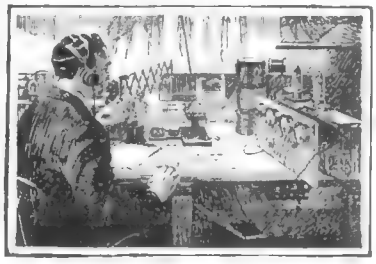

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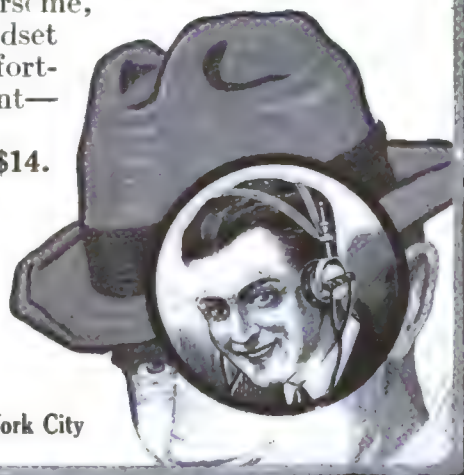

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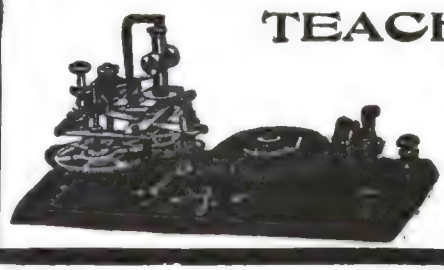

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A Radiophone and C. W. Set that Works

By ROBERT E. LACAULT

(*Continued from page 445*)

as modulators when the set is used for telephony, and three as amplifiers. Of course, a smaller number of tubes could be used, but in this case the range would be decreased accordingly. When more than two tubes are used, more power is obtained with the oscillator-amplifier circuit, than with all tubes used as oscillators. Another advantage is that when the set is used for telephony, better modulation may be had.

The two accompanying photographs show the front view and the inside of the set herein described. French tubes were used, but Moorhead or Radiotron tubes could be used instead.

In the circuit, the oscillator tube excites the amplifier tubes upon which is imprest the modulated current. The oscillating circuit consists of an inductance L1, made of 30 turns of No. 14 D.C.C. wire, wound on a tube 2" in diameter, and a .0015 mf. variable condenser C1. In order to have different ranges of wave length, taps may be taken out at the 10th and 20th turns. The fixt condensers, C2 and C3, are the stopping and grid condensers, and have a capacity of about .0005 mf. and .0003 mf. respectively. However, the exact value of the latter depends upon the type of tube used, and should preferably be found by experiment. The same may be said of the grid leak, G.L., which is of the carbon type, and made variable by a contact sliding along it. Its total resistance may be 10,000 ohms. The grid inductance of the amplifier tubes is wound on another tube, covering the inductance L1 of the oscillating circuit, and consists of about 56 turns of No. 22 wire, with taps taken every seven turns. This disposition allows the coupling to be varied by using one end or the other of this inductance. This coil may be seen on the right of Fig. 3.

The plate and aerial inductances are wound "in parallel" on the same 4" tube, that is, the winding is started with two wires, one being for the antenna coil and the other for the plate circuit of the amplifier. Thirty-five turns should be wound, making a total of 70, with taps taken every three turns after the 20th turn of the plate inductance, and every two turns after the fifth turn of the antenna coil.

Since the adjustment of coils L2 and L3 is not to be changed very often, it has been found unnecessary to mount extra switches on the panel; the taps on the coils are taken out in the form of small loops which are soldered on, and with which contact is made by means of a small bolt. Fig. 4 shows how these taps are made on the coil L3, and the method of winding.

In order to reduce the resistance, these two windings are made with No. 14 D.C.C. copper wire. The choke coil C.K., may be a standard one, of the type obtainable in any radio shop, but may easily be built as follows:

The iron core dimensions are shown in Fig. 5, and the coil itself is wound on a form made of cardboard or strong shellacked paper; 2,000 turns of No. 30 S.C.C. wire, with a thin piece of paper separating each layer, should be wound. The weight of wire required for this winding is slightly over ¼ pound.

The amateur, who does not care to build a modulation transformer, may use a Ford spark coil, but we would recommend the use of a real transformer, which may be wound on a core of the same type and size, as for the choke coil, which is shown in Fig. 5.

The primary, wound on a shellacked cardboard form, consists of 300 turns of No. 24 S.C.C. wire and is covered with one or

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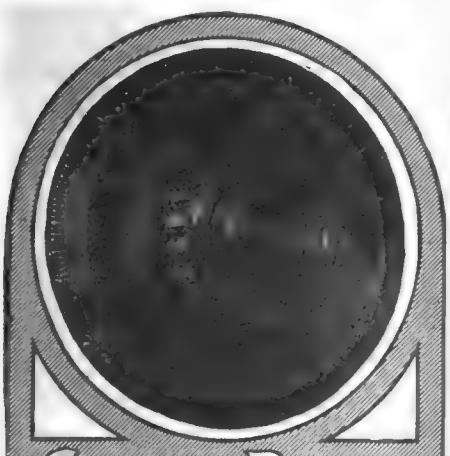

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two layers of paper to separate the windings. The secondary, wound right over the primary, should consist of 6,000 turns of No. 40 silk covered wire.

In order to keep the grids of the modulator and amplifier tubes to the proper negative potential, a battery with a potential of about 20 volts should be used. A standard "B" battery, of which the voltage may be adjusted by steps of 1.5 volts, is quite suitable for this purpose.

In the circuit, the filament battery is used to supply current for the microfone circuit, and the filaments of the two modulator tubes are connected with the microfone to the switch S.W. The current may be cut off from these tubes and the microfone, when the set is used for straight C.W. or I.C.W. (Interrupted Continuous Wave.)

If the set is to be used for transmission of messages with the last two systems, two binding posts should be provided for the connection to the key, and are to be short-circuited when the set is used for Radiotelephony.

Consequently, this set may be used: First, as a Radiophone giving excellent modulation; second, as a straight C.W. set; third, by inserting a *chopper* in series with the key, as an interrupted C.W. transmitter; and fourth, as a modulated buzzer set, if a buzzer and key are connected in place of the microphone. The two last systems allow the use of an ordinary receiver, such as a crystal set to receive the signals sent. As for the reception of speech no heterodyne or regenerative receivers are necessary.

Of course, the greatest range is obtained when straight C.W. is used, but a fairly good range is also to be had with the two other systems, i.e., I.C.W. and modulated buzzer.

In closing, the writer wishes to say that, the best way to make this set is to build each part separately, then hook them up on a table, and try the set. If something is to be changed, such as the value of inductance to suit a particular case or installation, or an aerial already made, it may then be easily done. When everything is found O.K., the various parts may be mounted, either panel or cabinet style, as preferred, the connections being made with No. 16 wire, and all the connections soldered.

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DEATH OF PROF. FRANCIS B. CROCKER

Professor Francis Bacon Crocker, sixty, founder and vice-president of the Crocker-Wheeler Electric Company, at Ampere, N. J., and formerly for many years head of the Department of Electrical Engineering at Columbia University, died recently at his home, No. 507 Madison Avenue, New York City. He had been ill for some time. Funeral services were held at All Souls' Unitarian Church, Fourth Avenue and Twentieth Street, New York City. He was former president of the American Institute of Electrical Engineering and of the New York Electrical Society. Professor Crocker, who was single, was author of many books and articles on the management of electrical machinery, electric lighting and motors.

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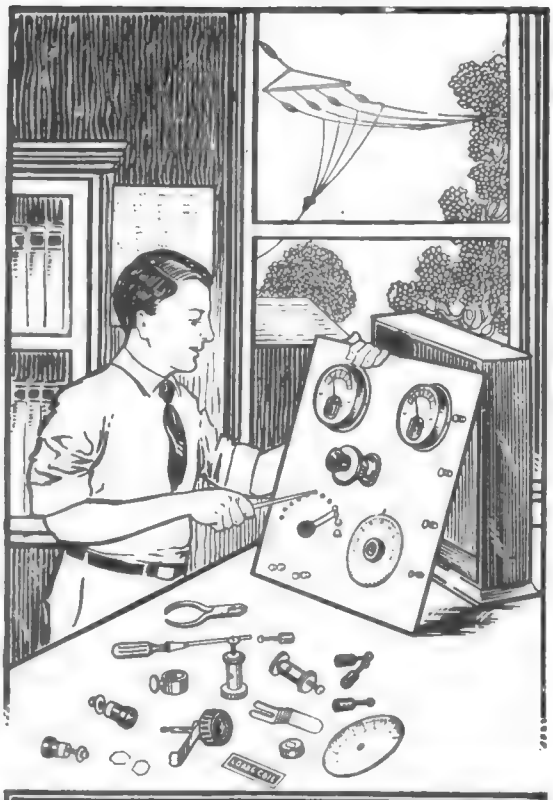

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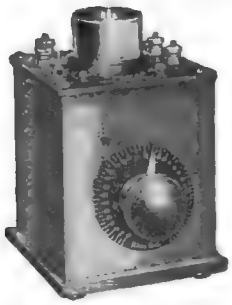

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Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page 433*)

comparatively large particles near the surface. The reddish color of the sun, moon and even of the stars and planets, when seen near the horizon, as well as the beautiful sunset tints, in which reds and pinks and yellows predominate, are due to the fact that these rays of longer wave-length are more successful in penetrating the dense, dust-ladened layers of the lower atmosphere. It is to be free of the dust and impurities as well as the unsteadiness of the lower atmosphere, that observatories are built at high altitudes whenever possible.

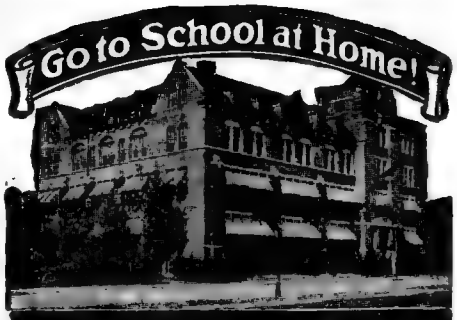
When there have been unusually violent volcanic eruptions, and great quantities of finely-divided dust have been thrown into the upper atmosphere, the effect upon the blue and violet rays from the sun is very great. The volcanic dust particles are so large, that instead of bending these rays of shorter wave-length, as do the oxygen and nitrogen of our atmosphere, they reflect them back to space and so decrease the amount of light and heat received from the sun. For this reason the general temperature of the earth is lowered by violent volcanic eruptions. Unusually cold periods, that lasted for months, followed the terrible eruption of Krakatoa in 1883 and of Katmai in 1912.

At times when much dust is present in the atmosphere, the sky has more of a milky white color by day due to the reflection of sunlight from the dust particles and the sunrise and sunset colors are particularly gorgeous with reds predominating. At such times the blue and violet rays are almost completely shut out, and the red, orange and yellow rays are powerfully diffracted and scattered by the dust particles in the air.

The twilight glow that is visible for some time before sunrise or after sunset is, of course, entirely an atmospheric effect caused by the reflection of sunlight to our eyes from the upper atmosphere, upon which the sun is shining, while it is, itself, concealed from our view below the horizon The atmosphere extends in quantities sufficient to produce twilight to an elevation of about sixty miles.

When *all* the rays of which sunlight is composed are reflected in equal proportions we get the impression of white light. Dust and haze in the air by day reflect all rays strongly and give a whitish color to an otherwise blue sky. Brilliant white clouds appear white, because they are reflecting all rays equally. Clouds or portions of clouds appear black when they are in shade or, at time, by contrast with portions that are more strongly illuminated, or when they are moisture-laden and near the point of saturation, when they are absorbing more light then they reflect. At sunrise and sunset, when the light that falls upon the clouds is richest in red and orange and yellow, clouds reflect these colors to our eyes, and we see the brilliant sunset hues, which are more intense, the more the air is filled with dust and impurities.

The familiar and beautiful phenomenon of the rainbow is produced by refraction, reflection and interference of sunlight in drops of falling water, such as rain or spray. As the ray of sunlight enters the drop of water, which acts like a tiny glass prism, it is refracted or bent from its course and spread out into its spectral colors. Reflection of these rays next takes place (once or twice, according to whether the primary or secondary rainbow is being formed) from the inside of the drop and a second refraction of the reflected ray takes place as it leaves the drop. The smaller the drops the



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more brilliant is the rainbow and the richer in color. The most brilliant rainbows are produced by drops between 0.2 and 0.4 mms. in diameter. In addition to the primary bow, which has a red outer border with radius of 42°, there is the secondary bow with radius of about 51° and with colors reversed, the red being on the inner border; the supernumerary bows which are narrow bands of red, or green and red, appear parallel to the primary and secondary bows along the inner side of the primary bow and the outer side of the secondary bow. No rainbow arches ever appear between the primary and secondary bows, and it can be shown, in fact, that the illumination between these two bows is at a minimum.

The primary, secondary and supernumerary bows all lie opposite the sun in the direction of the observer's shadow and the observer must stand with his back to the sun in order to see them. The primary and secondary rainbow arches are arcs of circles that have their common center on the line connecting the sun with the observer and at a point as far below the horizon in angular distance as the sun is above the horizon. It is, therefore, never possible to see a rainbow arch of more than a semi-circle in extent unless the observer is at an elevation above the surrounding country, under which circumstances it might be possible to see a complete circle formed by the rainbow.

The highest and longest arch appears when the sun is on the horizon, and the greater the altitude of the sun the smaller and lower the visible arch. As the angular radius of the primary bow is 42° and of the secondary bow 51° and as the common center of the two circles is always as far below the horizon as the sun is above, it is never possible to see either primary or secondary rainbow when the altitude of the sun is over 51°, or the primary bow when the altitude is over 42°. For this reason rainbows are rarely seen at or near noon in mid-latitudes, since the sun is there usually at an elevation of more than 42° at noon, especially in the summer season, which is also the most favorable season for rainbows, owing to the greater likelihood of rain and sunshine occurring simultaneously.

The light, which comes to an observer from the primary bow is once reflected within the drop, and that which comes from the secondary bow is twice reflected within the drop. The sharper and brighter light therefore comes from the primary bow of 42° radius. The space between the two bows is particularly dark, because it can be shown that the drops there do not reflect any light at all.

The rainbow colors are rarely pure or arranged in spectral order, owing to interference of light waves. It is the interference of light waves from different parts of the same drop that produces the bands of alternate maximum and minimum brightness, that lie below the primary bow and beyond the secondary bow. The red or other bands of maximum brightness produced thus by interference, are called the supernumerary bows, and they are always found parallel to the primary and secondary bow within the former and above the latter.

The distance of the rainbow from the observer is, of course, the distance of the drops that form it. A rainbow may be formed by clouds several miles distant or by the aid of the garden hose on our lawn. No two observers can see exactly the same rainbow because the rainbow arch encircles the surface of a cone whose vertex is at the observer's eye and no two such vertices can exactly coincide. Two observers see rainbows formed by different drops.

Refraction of light by ice-crystals in clouds produces many temporary color effects, such as halos of various types around sun or moon, vertical light pillars, circumzenithal arcs, and parhelia—"sun-dogs"—or paraselenae—"moon-dogs"—

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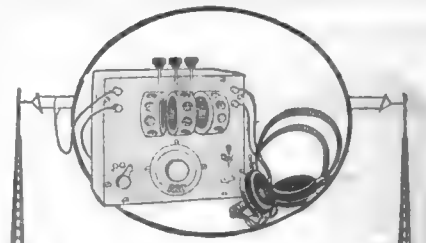

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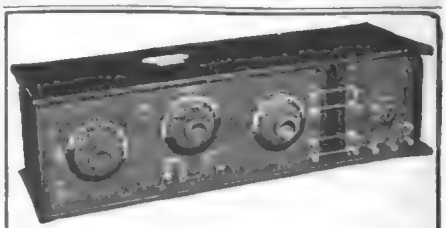

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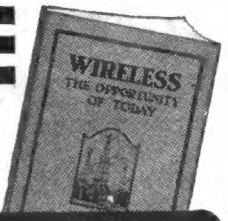

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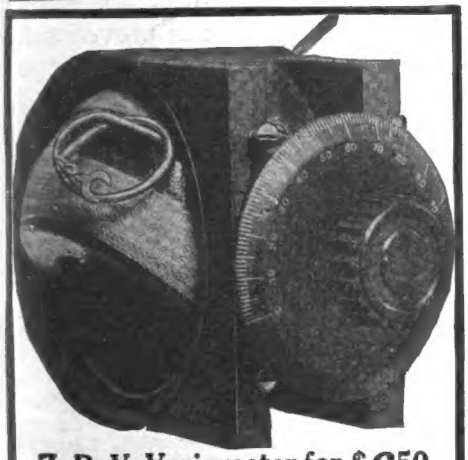

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which are luminous spots at equal altitudes with sun or moon—one to the left the other to the right, at an angular distance of 22°.

The most usual form of halo is that of 22° radius. This is a luminous ring of light surrounding sun or moon, with the inner edge red and sharply defined and the spectral colors proceeding outward in order; tho red is frequently the only color visible, the remainder of the ring appearing whitish. Since the halo is produced by refraction of light thru ice-crystals, and is due to clouds of a certain type gathering at high altitudes, it is always a very good indicator of an approaching storm.

Coronas are luminous rings showing the spectral colors in the reverse order, that is, with the inner edge blue instead of red. They are usually of very small radius, scarcely two degrees, closely surrounding sun or moon and are produced—not by refraction—but by *diffraction* or a bending aside of the rays as they pass between—without entering—very small drops of water in clouds. As in case of refraction, the red rays are turned from their course the least and the violet rays the most.

Many of these phenomena—halos, luminous spots, vertical pillars and arcs of light may, at times, be seen simultaneously, when clouds of ice-crystals are forming around the sun or moon. They then present a very complex and beautiful outline of luminous circles, arches and pillars that have a mysterious and almost startling appearance when the cause is not clearly understood.

We have found then that sunlight is made up of rays of many different wave-lengths and colors and that the atmosphere acts upon these rays in various ways. It reflects them or turns them back on their course; it refracts them as they pass thru the gases of which it consists, or thru the water vapor and ice-crystals suspended in it, thus sifting out and dispersing the rays of different colors and wave-lengths and producing beautiful color effects; it *diffracts* them or bends them aside as they pass between the fine dust particles and small drops of water in the air, again sifting out the rays of different colors and producing color effects similar to those produced by refraction; it also scatters and disperses, thru the action of the molecules of oxygen and nitrogen in the upper strata, the blue and violet rays of shorter wave-length and thus produces the blue color and brightness of the sky; it produces beautifully colored auroral streamers and curtains and rays of light thru the electrical discharges resulting when the rarefied gases in the upper air are bombarded by electrified particles shot forth from the sun.

It is our atmosphere, then, that we have to thank for all these beautiful displays of color that delight our eyes and give pleasure to our existence, as well as for the very fact of our existence upon a planet that without its presence would be an uninhabitable waste, covered only with barren rocks.

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Opening Safe Locks
By JACK HARTMANN

(*Continued from page 424*)

the second tumbler once. The third part of the combination is Right until 30 comes to the mark 2 times. The *first* time the dial is turned only the drive wheel turns; the *second* time it is turned to the right, the drive wheel has been turned twice, and the third tumbler once. The fourth (and last) part of the combination is Left, until 40 comes to the mark. This, in many cases, will only be part of a turn.

The Hall lock is a "double spindle" or a "separate-from-the-dial" spindle lock. Other makes have a single spindle, the dial spindle goes thru all of the wheels, e. g., S & G, Yale, and other makes.

When the dial was turned 4 times to the Right and stopped at 10 the slot in tumbler No. 1 was left in line with the lock dog. When turned 3 times to the Left and stopped at 20 the slot in tumbler No. 2 was left in line with the lock dog. (As we turned *4 times* to the *right* and *only* 3 to the *left* we did not disturb set tumbler No. 1.) Turning *2 times* to the right and stopping at 30 left the slot in tumbler No. 3 in line with the lock dog (and did not disturb tumbler No. 2). Turning 1 time to the left and stopping at 40 brings the slot in the drive wheel in line with the lock dog. (This was only one, or part of a turn, and did not disturb set tumbler No. 3.) Now all of the slots are in line ready for the lock dog to enter. In some makes of locks it enters from the top, in some from the left; in others, from the bottom. In good locks the lock dog is a part of the lock proper, but in the poorer grade it is just a part of the bolt bar. In some locks the dial turns to the right (last turn) raising bolt stop which gives free passage to bolt bar when the handle is turned. Again, in certain makes, the tee handle is turned (after combination is set) which slides the lock dog into tumbler slots.

When a combination is being set to open a safe, the only thing that can be "felt" or "heard" is the lugs or screws striking together and this is perhaps what writers, both fiction and scientific, think are tumblers "dropping," and which, I presume, is responsible for the statement on page 974, "With the aid of Rochelle salts and a sound amplifier, the almost noiseless falling of the tumblers is magnified many times." I do not doubt that this apparatus will magnify sound, but what good does it do when used to open a safe? Magnifying the sound of the tumbler lugs or screws striking will not help to open a Safe, for when the lugs are in that position, or anywhere near that position, the combination is far from set. Does the statement, "How to open a safe, without knowing the combination or wrecking the strong box, was next denonstrated," refer to a fact or a *near-fact?* The vibration of the "falling" tumblers may throw the salts into *spasms* —they *may* cause it to amplify and magnify, until it becomes a veritable shriek of agony, but I don't believe if it shot thunder and lightning and cracked like a 14-inch gun, it would help to open a safe.

For the past few years I have been corresponding with Safe men all over the United States and some in Canada but in all this correspondence I have never run across anything that at all resembles a "touch system," or anything that would lead one to believe that such a system existed. Some of my correspondents have served terms in our worthy institutions, the penitentiaries, including Sing Sing, San Quentin

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Stillwater, Black Island, Folson's Prison, Fort Worth, etc., and these gentlemen certainly would know it, if such a system did actually exist. They wouldn't go to all of the trouble of blowing the doors out, or even drilling and "puffing," if there is a way to merely manipulate the dial, and "listen to," or "feel" the tumblers "fall," or any other way to tell what is going on on the inside of the lock. Any time you meet a man who claims that he can open a safe or vault by the feel of the tumblers dropping, or by hearing them drop, you have either found a man who is mistaken, who is a super-human, or just a plain liar!

Herewith I present two sketches and two illustrations of three well known safe and vault locks:

Figure 1 illustrates a double-spindle or a separate-from-dial-spindle lock. Figure 2 shows a direct shaft lock. The cover has been removed to show working parts directly from the rear. When all three slots (A, B, C) in the three tumblers (or wheels) (D) have been turned until they are under the lug (E), indicated by dotted lines, the combination is set, for as soon as they are in this position the lock dog (F) falls, lug (E) entering tumbler slots (A, B, C) and the projection (G) of lock dog hooks over the arm (H). The dog stop (I) no longer offers obstruction to the lock dog for the lock dog is below the lowest point of the stop (I). When the dial is turned to the right last time (which it *always* is on this type of lock) the arm (H) is hooked over (G) sliding the lock dog (F) under the dog stop (I) and raising the *bolt stop* (J), which gives passage to the bolt bar when the handle is turned. The point or projection (G) rides on the spindle disk and keeps the lug (E) from rubbing on the tumblers excepting however when the point (G) crosses the space or pocket between (H) and (L) of spindle disk. This prevents "feeling" out the tumblers.

Figure 3 shows a different make of lock but it works on the same principle as the one shown in Fig. 2. Figure 4 shows lock of the same make as shown in figure 3. On this lock the lock dog enters from the bottom instead of from the top. In Fig. 3 the lock dog drops from its own weight, while in Fig. 4, the heavy end (A) causes it to enter, but both are *direct shaft* locks.

Often we hear some one saying that it is possible to work out or try all of the possible combinations on a safe or vault lock. It is possible and it works well on padlocks and also on safe locks that have combinations, having from 10 to 1,000 possible changes in combination; *but* what are we going to do with a safe lock, similar to one in Fig. 2, that has 100,000,000 possible combinations? If a man is fast enough to try 10 per minute, works 10 hours a day, and every day in the year it will take him—Get a pencil and figure it out for yourself! When you start figuring remember that he might miss one—the one he needs.

I haven't a lot of money to throw away but I will give $100.00 in cash, train fare and expenses to anyone who can open five of our leading makes of safes, having standard locks (that have not been tampered with) by "hearing the tumblers fall" or by a "touch" method; no mechanical or electrical appliances or apparatus to be used. He will be given 5 days, of 10 hours each, in which to open the 5 safes. Five local merchants and business men (preferably the owners) will be the referees or judges; and the makes of safes will be named by myself. The only reason I wish to name the safes myself is to be sure they have a good lock with 10,000 or more combinations so that there is little chance of "blundering" on to the combination. If he fails to open the five safes in 50 hours, he will donate to the Salvation Army an equal amount of money, after each safe has been examined by two locksmiths or safe men, to see that the locks have not been altered or tampered with in any way, and that everything has been fair and square; one of these men to be selected by him and one by myself. The locks will not be examined by either him or me before the test. Just after the test, in case he fails to open them, each safe will be opened by the owner in his and my presence to prove that the locks are working (Address editor for address).

This challenge is not aimed at safe men for they know better than to make "breaks" about "touch systems" and "hearing 'em drop." It is aimed at "Stage Safe Experts" who repeatedly make statements along these lines.

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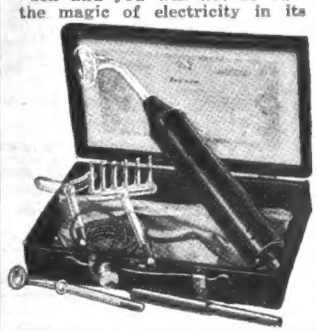

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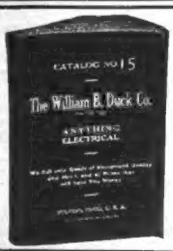

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